LECTURES & LETTERS

New-York Tribune.

EXTRA, No. 15. 20 CENTS.

LECTURES AND LETTERS.

Discoveries on the Site of Ancient Troy:

Brown-Sequard's Lectures on the Nerves.

Proctor's Farewell Lectures on Astronomy.

The Germ Theory of Disease.

THE WEEKLY TRIBUNE.

TO MAIL SUBSCRIBERS.

One copy, one year—52 issues ..... **$2.00** | Five copies, one year—52 issues **$7.50**

TO ONE ADDRESS,
ALL AT ONE POST-OFFICE.

10 copies ..... **$1.25** each.
20 copies ..... **1.10** each.
30 copies ..... **1.00** each.
AND AN EXTRA TO EACH CLUB.

TO NAMES OF SUBSCRIBERS,
ALL AT ONE POST-OFFICE.

10 copies ..... **$1.35** each.
20 copies ..... **1.20** each.
30 copies ..... **1.10** each.
AND AN EXTRA TO EACH CLUB.

Terms of the Semi-Weekly Tribune.

One copy, one year—104 numbers **$3.00**
Five copies, or over, for each copy **2.50**
Ten copies (AND ONE EXTRA COPY) for **25.00**

Terms of the Daily Tribune.

To Mail Subscribers ..... **$10** a year.

THE TRIBUNE ALMANAC for **1874**, price **20** cents; 7 for **$1**.

BROWN-SEQUARD'S LECTURES.

The following course of six lectures was delivered by Dr. Brown-Séquard of New-York, at the Lowell Institute, Boston; beginning Feb. 25, and closing March 18, 1874:

NERVOUS FORCE—THE FIRST LECTURE.

TRANSFORMATION OF LIGHT, HEAT, ELECTRICITY, AND CHEMICAL FORCE INTO NERVOUS FORCE.—A GUINEA PIG SURVIVING AFTER THE MEDULLA OBLONGATA WAS CUT AWAY.—NERVES KEPT ALIVE FORTY HOURS AFTER SEPARATION.—COMPARATIVE POWER OVER THE NERVES OF OXYGEN, STRYCHNINE, AND THE WILL.—THE UNITY OF THE NERVE FORCE.

[FROM AN OCCASIONAL CORRESPONDENT OF THE TRIBUNE.]

BOSTON, Feb. 26.—The popularity of this course of lectures may be seen from the fact that a supply of tickets equal to the full capacity of the hall of Lowell Institute was disposed of within three-quarters of an hour after the office was opened.

Those who know of Dr. Brown-Séquard's devotion to Prof. Agassiz in his last sickness need scarcely be reminded of the great affection they entertained for each other. The Doctor's tribute to the memory of his friend did not fail to awaken the sympathies of his audience. The lecture was as follows:

LADIES AND GENTLEMEN: I have no doubt you will excuse the emotion that is upon me at this time. Last year when I met you here, there was sitting there a man who certainly deserved the great admiration that has been bestowed upon him, and whose qualities of heart were so great, that although I admired him more than I admire any one, yet I loved him still more. His absence to-day justifies the feelings that are now upon me.

The lectures I have to deliver here are on a subject which is full of interest, and which deserves more study than it has obtained. The various effects produced by nervous force are certainly, even for persons who have nothing whatever to do with medicine, full of interest, and I may say of importance. I will go further. I have no doubt that persons who have not at all engaged in the medical profession could do more perhaps than physicians, in regard to discovering certain of the peculiarities of nervous force. Physicians unfortunately—I speak of myself as well as of others—are biased. Their bias prevents progress. They have received an education which has given them certain notions, and those notions prevent a free examination of certain questions. The unbiased minds of persons who have not studied medicine, or who, if they have studied the foundations of it, have not engaged in the practice of the profession, permit them to investigate and discover. Perhaps as a result of the lecture that I shall deliver here, it will be given to some of you to push forward discoveries in that line.

Before entering into the proper subject of this lecture it is essential to pass in review some of the elementary questions of physiology. I shall do it very rapidly. There are two elements in the nervous system which are united together, but which are, however, absolutely distinct, the one from the other. One consists in the nerve cell, which you see represented on the board. I have made it nearly round, but it is very rarely that it is so. That cell has starting from it a number of filaments. In the spinal cord and in the brain those cells generally have one element entirely different from the others, and that element is similar to the other element we find in the nervous system: that is, fibers. There are therefore two kinds of elements in the nervous system, the fibers and the cells, with their prolongations. What becomes of those prolongations is not known, and it may perhaps remain always unknown to us in this world. It is to be feared that the power of our microscopes will remain pretty nearly what it is, and if that be the case, then we shall never know much more as regards the ramification of those fibers. But the remarkable point of which I have not yet spoken, and which you ought to keep in mind, is that the fibers of the nervous system are united with those cells. Within the nervous centers, that is, the brain and spinal cord, there is but one of those fibers united with cells. In other parts of the body there are cells which have two real fibers starting from them besides the ramifications.

A DEATH-BLOW TO ANIMAL MAGNETISM.

Now the nervous force is produced in those elements of the nervous system. I have no need, of course, to give a definition of nervous force, or nerve force, as you will perhaps prefer to call it. It is that force which manifests itself in nervous actions. The nerve force belongs only to the elements I have described. Are there any instances in which we can find nervous force without the existence of those two elements? This question is now decided in this way. There are animals in which, and there are circumstances in man in which, the nervous tissue does not exist evidently in the way I have described, and still there is a nervous force; so that it appears that nervous force can exist without the nervous elements. There are conditions, especially in monsters, where the spinal cord, instead of being organized, is a fluid in which elements resembling those of the nervous system are not recognized, and still there is nervous action, and therefore, nervous force. In some low forms there are also tissues which do not represent at all the known elements of the nervous system, but in which, nevertheless, there is nervous action, and therefore nervous force. A professional friend in Paris has shown that there are certain instances of disease in man in which the nervous system is so transformed that it is hardly recognizable, and yet there is every probability that it acted, and that nervous force was manifested.

But the great question is not there. The great question is whether the boundaries of the nervous system are also the boundaries in health of that nervous force. In other words, can the nervous force spring out of the nervous system to produce some action? As regards this, I may say that there are no facts to prove it. You can easily understand that if I am right, this is a death-blow to what is called animal magnetism. But this is a point that we will debate more at length by and by. All I wish to say in this introductory lecture on this point is that there is no likelihood at all that nervous force can get away from the limits which are constituted by nervous tissue. There is no question, however, that nervous force can manifest itself outside of the boundaries of the nervous system; but it manifests itself often after having been transformed into another force. It is well known that nervous force is transformed into motor force. This I am doing at present. It is owing to motor force that I have any voice at present. This transformation into motor force takes place at every moment of our lives. Other transforma-

fects them by dilating them, but because of the direct transformation of nerve force into chemical force producing an attraction of blood. A great many facts indeed show us that circulation will go on without an impulse from the heart. In plants the circulation proceeds from chemical changes without any heart at all, without any power that pushes the liquids forward. In fœtal monsters in our own species, there are cases in which the monster had no heart, and in which the communication of its circulatory system with that of the almost half child with which it was connected, was too slight for the circulation to go on if we were to look upon the heart as the only organ producing circulation. Besides, in embryos, in animals at a certain degree of their development form the ovum, circulation takes place while the heart is not yet formed. And we may say that instead of the heart being the only organ that serves for circulation, that, on the contrary, the heart is formed by circulation. The circulation helps to give it a form of organization, and helps to give it a function when it has accomplished its organization.

I long ago made an experiment with frogs, consisting in making a section of the ventricle of the heart, dividing it so as to do away with more than two-thirds of the length of that part. After a time a clot is formed there which unites the lips of the cut, and the circulation goes on with a part of the ventricle, which is so small indeed that there is hardly an impulse coming from it. There is a passage, however, for the blood there, and that is all that is necessary, that the great cause of circulation, which is attraction, may be accomplished in every tissue through life. Even in our own species it has been my lot to see one case, that of a lady, in which the heart was almost entirely destroyed by fatty deposition. The heart in this case had very little action, if any, but still life persisted for some time. In appearance there was a state of health, until suddenly one day death occurred. There is on record the case of a man who for three days had had no beating whatever of the heart and who, nevertheless, had had a circulation. He had had no pulse—the beating of the pulse depending on the heart—but the blood was circulating, and life was maintained all the time. Therefore, although I would not say certainly that the heart is a useless organ [laughter], it is certainly by far less important than it was considered to be, a great deal of the work of circulation being due to the attraction that tissues exert on the blood. That attraction is increased by certain nerves, and thereby circulation is considerably increased, sometimes locally to a most wonderful extent, by an irritation of the nervous system. In cases of inflammation we see this very plainly. Where the inflammation exists inside of the cranium, we find that the carotid artery beats with tremendous violence. Sometimes we find an enormous increase of pulsation in the arteries of the temple. As we find in such cases that the heart, as indicated by the pulse in the wrist, is not beating with much more force than usual, we must conclude that there is considerable irritation and an inflammation in the membrane of the brain or the brain itself.

A CAT'S TAIL ON A ROOSTER.

If we put an organ taken from a living animal inside of another animal, very frequently this organ will be engrafted there. The infused serum becomes the object of chemical changes, the blood is attracted and the organ receives circulation. I once engrafted the tail of a cat on a cock's comb. A few days after it was evident by pricking the tail that blood was circulating in it, and it certainly would have stayed there had not the cock had a fight and lost its tail. [Laughter.] Other cases of grafting leave no doubt in this respect. It is shown by the fact that *ova* in animals when they are implanted on a mucuous membrane take hold of it, blood is attracted there and circulation takes place.

Now, the question is, does the nervous system which acts so powerfully on nutrition, as you will see in a moment, act only through blood vessels and through that peculiar influence which I had named an attraction of blood? Certainly not. Whatever be the suppositions we may make as regards the mechanism by which the alterations I will speak of are produced, it is quite certain that we cannot explain all the facts on the supposition that the nervous system affects nutrition only through the blood vessels. There must be other influences. And the variety of facts I shall mention, although not so great as I should like to present, will be sufficient, I think, to show that we cannot accept that position.

The mere division of a nerve is followed by a good many alterations, often producing atrophy not only of the muscles but also of the cellular tissue of the blood vessels, and also of the bones themselves. All the parts that were animated by the nerve are more or less atrophied after division. Dr. John Read made an experiment to ascertain whether it was because the nervous system has an influence on the nutrition, which is essential, or whether it was simply the lack of action, the perfect rest in which the part was thrown, that occasioned this wasting away or atrophy. He allowed atrophy to take place, and then galvanized the limb very frequently, and found it improved. But the principal experiment consisted in preventing atrophy by galvanization. He galvanized every day, and found that the limb did not become atrophied. I pushed the experiment further. I waited until atrophy had become considerable in the limb, and then I applied galvanism. I then learned that although the nerve had lost nerve force altogether—as they lose it four days after dissection—yet there was soon a manifest increase in size, and after a time the limb was brought to the normal size that it had before the operation.

Even in man we frequently see cases of that kind. I once had a patient who from rheumatism had been without any exercise in one of his legs for a long time and atrophy was considerable in the thigh. When the pain had diminished considerably he began to apply galvanism. I observed day after day a change for the better, and at the end of a week he had gained at the upper part of the thigh five centimeters or nearly two inches in circumference. This implied a rapid transformation for the better. It is evident, therefore, that in a great measure it is owing to rest or inactivity of a part that want of nerve action and consequently atrophy is due.

CONSEQUENCES OF IRRITATION TO NERVES.

There is a great variety of results, as I have said, when any part of the nervous system is irritated. The irritation may come in a direct way; that is, it may, if it exist in the brain or part of the spinal cord, go direct to the muscles or skin or bones or glands or part with which it is connected. But there is another way. An irritation may start from a part of the skin or mucous membrance and go up to the brain or spinal cord and be sent back by the brain or spinal cord toward other organs which become atrophied. There are a number of cases which show that an irritation in the bowels or elsewhere, in the skin, for instance, from a cut, has produced an atrophy at a distance in other parts of the body. The variety of effect produced is considerable.

there, and that for a long time after death. But how is it that suddenly it disappears from the nervous centers, so much so that respiration, circulation, and all voluntary and involuntary movements cease? To answer this question would require no little study and investigation, and the person making it would have much to find that would be interesting. We find, however, in making these experiments that we can take away the part which has been considered as the focus of life, by employing certain simple precautions, without destroying life. At the College of Surgeons in London, in one of my lectures there, I had tried to show that death in the cases referred to is immediate. I had an animal—a guinea pig—on which the experiment was to be performed. In making the experiment my knife slipped and went all around the part, carrying away more than I had intended. The pig survived three or four days until my boy, trying to make the pig squeal, drowned it. [Laughter.] The vital focus, so called, does not deserve the name; for there are many cases in which it has been destroyed, and life persists. Therefore, we cannot look upon it as being a center for vital force or nervous force.

This leads me to examine now the question, What are the places of production of nervous force? Those places of production, I may say, are as extensive as the nervous system. For a long time physiologists had considered that the cells were the only parts that produced nerve force. But I have ascertained and proved, and I think most physiologists now admit, that nerve fibers can also produce nerve force. In experiments consisting in injecting blood into a limb which has been separated from the body for a long time, I have ascertained the nervous force which had disappeared has been reproduced. So that it is clear that nerve fibers can engender nerve force. If we separate a nervous center from the nerves we find that in four days the nerve has lost its power altogether. It seems, therefore, that something came from the nervous center which was useful in the production of forces there. But it is clear, too, that there are other forces reproduced in the part. If we allow the part to receive more blood the injection will reproduce nervous force again. I have kept a nerve alive apart from the body for 40 hours by injecting blood in it. The nerve force, even in the brain, can be reinvigorated when the brain has lost all power and is separated from the body. An injection of blood reproduces nerve force again and all the activity of the brain when in the animal is found to be manifested. In one case, that of a patient of mine who had had a dissection of a nerve, the nerve continued to act spontaneously for four days, and the muscles to which that nerve went were in contraction for the same length of time, owing to the persistence of life and action in that nerve separated from the brain. After four days the transformation which we know can take place in the nerve tissue had destroyed nervous activity, and the muscles then remained quiescent, completely deprived of action.

There is an organ in the body whose functions have been very much discussed. That organ is the cerebellum. In man it is a very large organ indeed. I shall not discuss its functions here, but I will say that there is no doubt that the cerebellum is one of the principal foci, one of the principal places where nervous force is produced. In many animals the principal place is the spinal marrow. But in man the cerebellum is the great focus of the production of nervous force.

POWER OF OXYGEN, STRYCHNINE, AND THE WILL.

What now is the agent of production of nervous force in our blood? It is clear that blood itself must be necessary to the production of nerve force. Still for a time the oxygen alone which is carried by the blood may suffice. Oxygen, even when the blood seems to have been taken away altogether from the part, can give some nerve force to the nervous system; but there is a medicinal agent which has immense power in producing nervous results. When the spinal cord of a frog has been washed of every drop of blood, when injections have been made of pure water so as to carry away every particle of blood, if strychnia is put on the spinal chord, in a very short time the amount of "reflex power," which is a manifestation of nerve force, is very much greater than it was before, showing that strychnia has increased that power. This is the only fact we know, which clearly proves that a medicine, putting aside oxygen, can have such a power, and a power, indeed, which is very great.

What is the power of our will on the nerve force? This is a question which a great many patients every day ask themselves. There is no doubt that nerve force is very little under our will. It may be an admirable provision of nature. It may be that we would spend it very foolishly, as we do spend many other things. Still there are many circumstances when the deficiency of will power is really painful, and in patients in whom the amount of nerve force is immense. I have tried to measure the amount of nerve force in a frog. I have ascertained that a frog could lift a weight of 20 grammes to a point which was about a line and a quarter, 600 or 700 times in an hour and a quarter. This is an immense amount of nervous force, and manifested, too, when the spinal cord was no more receiving blood, when there was no more circulation. In this case the frog was beheaded. Compare this with the case of a frog having its head. The frog with a head, after a very short time, could not move at all willfully; while still the reflex action, as we call it, an irritation of the skin, determined a strong movement. There may be, therefore, in certain circumstances, an immense amount of nerve force accumulated in the system. I would not say that there is no more production immediately after the cessation of circulation. I had not washed the vessels. There was blood left there; still there was not much of it, and it was not charged with oxygen after a time.

There is an immense difference as regards the amount of nervous force that remains in the system after death according to many circumstances, and especially according to temperature. If we have considerably diminished the temperature of animals having a great heat, such as we have, and we then kill them by means that will not bring on convulsions and an expenditure of force, we find that the amount of force that remains is considerable, and that it will remain there a very long time. In cold-blooded animals, when the temperature is very near freezing point, the amount of nerve force that remains in them for a very long time is also immense, while at a high temperature the transformation of nerve force into chemical force is very rapid, and then the expenditure of nerve force is total after a time, which is not long.

The principal question I have to examine in this lecture, however, is the one I shall now speak of; namely, is there unity of force or only one nerve force, or are there many in our system?

I have for a long time tried to prove that there is unity of nerve force. If we spend force, either in the way I am now doing, by mental more than by physical

labor; if we spend force with the pen in hand, when we are studying quietly at a table, we find, after having been at work three or four or five hours, that the nerve force that remains for physical exercise is diminished. We have drawn force from a focus which is the same that gives it for mental action and for physical exertion. If, on the other hand, we walk 20 miles and find ourselves physically tired, we find then that very little nerve force remains for mental action. There are facts, however, which seem to be in opposition to this, and those facts will be fully explained in the last lecture, when I come to explain the laws of production and expenditure of nervous force. I may say this much, however, just here, that it is perfectly well known, contrary to what I have said, that we can do better with our brain if we have had some exercise than if we have had no exercise at all. But it is simply that a certain amount of exercise has led to the production of nervous force by improving the circulation, improving the secretions, improving respiration, and improving in fact all the great organic functions through which the secretion of nervous force takes place, so that we have become richer in our force because of the exercise we have taken physically. There is no doubt, therefore, that moderate exercise will lead to a production of nerve force and facilitate the exercise of our brain power; and there is no question that if we draw too much of the nerve force of our system, if we draw a great deal more of it than can be reproduced during a certain time; if we walk, for instance, very fast for five or six hours, we are then unfitted for mental work and for a good many other things. Our respiration becomes difficult. Our heart, after having beaten with much rapidity, comes to beat very slowly. We are weakened in every organ whose action depends on nervous force. There is no doubt therefore that there is a common focus of nerve force on which we draw for any of the activities of our system employing nerve force. Looking through a microscope for several hours, as micrographers know full well, is a cause of great fatigue, and renders mental work or physical labor thereafter more difficult.

THE UNITY OF NERVOUS FORCE.

There is one experiment that shows that nerve force is distributed as galvanism would be on a cylinder. Suppose a cylinder in the shape of my arm; suppose that this is charged with a certain amount of electricity, and suppose that this arm or cylinder is then cut in two just in the middle of its length; there would be in each half of the arm then an amount of electricity which would be just one-half of the amount that existed before. Suppose that the whole arm had manifested a force equal to twenty measures, the half of the arm would manifest a force equal to ten. So it seems to be with the nervous system. If we divide the cord across, as in a bird, behind the upper limbs, we find that the bird cannot make use of its limbs as before. The amount of force is not sufficient in the upper part of the nervous system. So it seems that nervous force is distributed all over the nervous system, and that if a cause operates to divide the nervous system into halves, each half has only the amount of nerve force which it had before.

There is one objection in appearance to the view that there is unity of nerve force, and that is that the brain is a double organ; that we have two brains instead of one. About that allow me to say that although we have two brains it is pretty much as if we had but one, as by the force of our education one only is raised to power The other is left with very little power indeed. It would be very easy, as I may hereafter show, to develop fully the power of the two brains by proper education. But if we have two brains there is no objection to the view that there is a unity for the nervous force. It is no objection because these two brains are united. There is communication. Every part of our nervous system is in communication with the other. We cannot touch a part of the skin or any other part of our system without producing a commotion all over the nervous system; in the same way that we cannot stamp our foot on the ground without shaking the whole world, and not only our world but the rest of the universe is shaken by such a simple thing as that. Of course, a very little shaken [laughter], but shaken nevertheless. There is no doubt that any action on any part of our system is felt everywhere through it. And that is the reason why many persons suffering in their nervous system cannot have an excitation brought on any part of the body, as it increases the trouble where it exists.

A few questions remain to be examined before closing the lecture. One is, how happens it that there are so many differences in sensation if there be but one kind of nerve force. This is not a great difficulty. The variety of sensations has an organic cause, of which I may have an opportunity to speak in another lecture. The nerve force is only an agent, most likely the vibration of a certain agent, and the vibration according to the location will produce one effect or another. The parts of the nervous system are not all alike; they certainly differ one from another, and the vibrations may be greater or less, so that we can easily be reconciled to the variety of sensation, although we admit but one kind of nerve power.

There is another question. That certain fibers seem to act on muscles, and others seem to restrain the nervous action. This is a point of such great importance that I shall give a whole lecture to that subject. When cells are active, either morbidly or naturally, an irritation coming from a nerve and acting certainly through nerve forces may be sufficient to stop the power of that nerve cell. That seems to be an act completely different from that by which a muscle, for instance, is put in action by the vibrations taking place; the transformations of nerve force taking place in the nerve, and also all the other actions that I spoke of—the emission of light and electricity. All these things may seem to imply some different action. But if you admit the great doctrine which exists now in science, and which has revolutionized natural philosophy as well as chemistry; if you admit that there is never a loss of force; that force is accumulated and that it is only transformed when it disappears, then you can easily admit that nerve force has been transformed in those various organs into some other force and that there lies the cause of the different actions of which I have spoken. But the difficulty exists, however, for that special case in which an action ceases in the cell. Suppose a person to have an attack of epilepsy. His head is thrown to one shoulder and he has not yet lost consciousness, and some one comes and draws the head to the other shoulder and the fit ceases. Well, there has been in that case an irritation starting from certain nerves when the head was moved, and this irritation goes to the cells of the gray matter that were active in producing the convulsions and stops the action of those cells. But the stopping of the action of cells is something different from the production of ne-

tion. Therefore it may seem quite different. But we may admit, however,—and it would be most important indeed for chemists to make researches in that respect—we may admit that a chemical change is the result of that transformation; that the nerve force is transformed into a chemical force, and that chemical changes occur in the cell, very rapidly and in great quantity, just enough to replace the whole amount of nerve force that was acting before. Therefore, there is no reason *a priori* not to admit the possibility and the probability that nerve force is the same in every instance; that it affects cells of gray matter to stop them in the same way that it can put cells into activity; in the same way that it can put muscles into activity, and that it can put an organ into activity.

NERVOUS INFLUENCE—SECOND LECTURE.

SOME OF THE FACTS THAT ARE DIFFICULT TO EXPLAIN—A NEGRO REDUCES CONVULSIONS BY PULLING AT THE GREAT TOE—MORE PERSISTENT VITALITY IN AMERICA THAN IN EUROPE, BOTH IN MEN AND ANIMALS—VARIOUS RELATIONS BETWEEN THE NERVOUS SYSTEM AND THE ACTION OF THE HEART—METHODS OF CHECKING CONVULSIVE EFFORTS, SUCH AS COUGHING, &C.

BOSTON, March 1.—Dr. Brown-Séquard delivered his second lecture to a large audience:

LADIES AND GENTLEMEN: In the last lecture I tried to show several points relating to the force which we know to exist in nerves. I particularly insisted on what I call the unity of force in the nervous system. I especially tried to show that every nervous action is the cause of an expenditure of nervous force. There are a few facts, however, which may be considered as constituting an objection to that. I will mention some of them. The principal one is, that we know full well that certain parts of the body may be extremely weak while others remain strong. But that certainly is no objection, since if we admit that the communication is obstructed between the part which is weakened and the rest, it is quite natural that there should be a diminution of force in that part. Besides this, there is something in the nervous system as well as in the muscles that permits a reaction after an irritation. There is a property of nervous tissue and muscles especially which we call excitability. The excitability of the nervous system is entirely and absolutely independent of the amount of nervous force. Perhaps it is wrong, however, to say as I have just done, that there is no dependence of one upon the other. There may be a dependence in this way, that the greater the amount of nervous force, the less excitability there is, and *vice versa*, the greater the amount of excitability the less amount of nervous force. People who have been ill; people who are naturally extremely weak, or those who have lost a good deal of blood and have been weakened in that way; in other words, people who have very little nerve force, are, as is well known, extremely excitable. They will jump at a noise and in other ways show nervousness. There is, therefore, something quite distinct in these two things—excitability and nerve force. This property of excitation is nothing but the power to receive an excitation. Persons who are extremely strong, will not generally be moved by excitation. They will, of course, appreciate the excitation; they will judge what it is; but they will remain calm under it. While, on the contrary, persons whose nervous system is weak, and who have little nerve force, will react under any excitation, however slight, without giving to the mind time to think of what the excitation is.

I said in my last lecture that the nervous force is quite different from electricity, that it is a force by itself; but I must add to this statement another one, that the nervous system is more or less charged with electricity all the time in health. The two forces, electricity and nerve power, are both present; but not always in proportion one to the other, as sometimes there may be an opposite condition. But certainly the nerve force is not electricity, as we well know that the speed of the nerve force is only from 80 to 300 feet in a second, while the speed of electricity as you know is thousands and thousands of times greater.

THE INFLUENCE THAT IS EXERTED UPON THE NERVES.

I now come to the principal object of this lecture, which introduces a subject that must extend to one or two more lectures—that is, the influence that the nervous system exerts upon itself by the force that we call nerve force. There are two kinds of such influence, which are absolutely distinct one from the other. One consists in the production of the activity, either normal or morbid; the other consists in the cessation of the morbid or normal activity. These two great influences of nerve force, acting upon parts at a distance more or less great, cover almost all the facts relating to the influence of the nervous system upon itself. I shall this evening enter more fully into the history of facts which show that the nervous system can stop the action of a part of its extent. All we know on this subject is of comparatively recent discovery, and the principal fact developed is that which relates to the heart. The brothers Webber discovered that the heart in a perfectly healthy man may be stopped suddenly in its action in a way which is quite different from that which regards muscles generally. If we galvanize a muscle that has been more or less in contraction by a current passing to and fro, stopping and passing again, so that the muscle is contracting and relaxing, as I show you now in this movement up and down exerted by the front of my arm—suppose that this is acting, and I pass a current into the nerves that goes to the muscles thus acting—immediately the movement stops; so that there is something similar to the cessation of the action of the heart. But the action stops, not because the muscles have stopped acting. On the contrary, the muscles are acting with a wonderful power, the greatest that they may have under the amount of electricity that is passing; and the contraction remains perfectly fixed so long as the current passes. This is the production of an active state in the muscle, and not the production of a passive state. According to the discovery of the brothers Webber, when the big nerve in the neck that goes to the heart, and which we call the *par vagum*, is thus influenced, the heart stops, passively, not actively, like the muscles of my arm. The walls of the heart remain perfectly flaccid, perfectly motionless from want of activity. During that time the heart is filled more and more by blood reaching it, and it becomes very much distended after a short time, as it does not reject the blood it is constantly receiving. There is, therefore, in that stoppage of the heart's action a phenomenon quite peculiar. And it is a phenomenon which implies a certain kind of activity. For although there is a passive effect obtained, a passivity produced in the heart, there is an activity in the nerves that go to the heart to produce that cessation. There is an influence upon certain parts of the heart belonging to the nervous system, and it is certainly an ac-

tivity although it consists in stopping a movement. It is just as if you were to stop the wheel of a carriage by pushing a wedge under it forcibly.

ACTION OF THE NERVOUS SYSTEM ON THE HEART.

The great agents of the rhythmical movement of the heart are small ganglia, composed of cells of gray matter. They are suddenly rendered passive by the peculiar influence exerted upon them. Such an effect has been observed, first, by the galvanization of the nerve of the neck that I spoke of; and it was afterward found to appear when the medulla oblongata, or center from which that nerve starts, was galvanized. In experiments made by a French physiologist—Legallois—it was found that the crushing of the medulla oblongata produced an arrest of the heart. But he did not discriminate between that kind of cessation and death. He thought that death was caused by this crushing of the medulla oblongata, and that the heart had ceased because it had lost the source of its action. When I took up the question I found that a simple pricking of the medulla oblongata could produce an arrest of the heart's action. My friend, Prof. Charles Rouget, who took up the question of the mechanism of the phenomena by which an organ is arrested in its activity, considered that what takes place in the heart is similar to other phenomena which he noted at the time he published his paper. He established this law: that all such phenomena—which I shall call the phenomena of arrest, though in English they are generally called inhibitory phenomena—occurred always through the same mechanism. An irritation starts from a part which can convey nervous force, and the nervous force so conveyed after that irritation, reaches the cells of gray matter which were active, and those cells of gray matter are immediately stopped by that peculiar influence.

For another illustration of this mechanism we are indebted to the observation of a very intelligent negro, whose master was affected with a disease of the spinal cord which produced convulsions in the lower limbs. The most intense stiffness would manifest itself in the lower limbs. They were rigid like a bar of iron for a time; and after ten minutes of this extreme rigidity they began to have violent jerks. The jerks then disappeared and the rigidity returned. All day long the lower limbs were in this state of muscular contraction. His servant, the negro, having to dress him, found it very difficult to put on his pantaloons. One day, he by chance took hold of his big toe, and found as he pulled it that the limbs became perfectly soft and movable. The convulsions had disappeared altogether. The negro certainly had a natural genius for science. [Laughter.] He learned the meaning of the fact. He learned that whenever he wanted to push his master's pantaloons up, he had only to pull his big toe down. [Laughter and applause.] He succeeded every time. And as the master found the cessation of the convulsions useful at other times besides when he was dressing, the negro was asked very frequently to act on the big toe in order to effect it. [Laughter.] This fact is not a unique one. I have seen 14 such cases. Many of my medical friends have seen them also. In fact it seems somewhat a rule in cases where there is a certain disease of the spinal cord limited to a certain part, that this will be found. In this case you find exactly the same thing that exists in the heart when the *par vagum* is galvanized. In both instances there is a nerve that conveys irritation to the cells. In the case of the heart the nerve goes to the cells that are in the heart. In the case of the big toe, the nerve goes to the cells that were in a morbid state producing those convulsions. In the one case, that of the heart, the phenomena of movement were nominal; in the other, the phenomena were morbid. Still, it was the same mechanism in both. In both instances a cessation of activity was produced.

PRESSURE ON THE NECK TO CHECK THE HEART'S ACTION.

A friend of mine, Dr. Waller, a most intelligent man, a man of genius—although he was not a negro—found that by pressing on the neck he could produce the most interesting physiological phenomena. He has succeeded in that way in curing headaches, neuralgia of the face, and many other affections in which there was pain or great congestion of the head. An attack of epilepsy may be stopped in that way. Many physicians before him had produced some of those results, but they all thought it was from a pressure of the carotid artery. Dr. Waller has the merit of showing that it is chiefly—he thought it was only, but I have found that it is chiefly, not only—through an irritation of that nerve, the *par vagum*, that the motion of the heart is arrested in those cases, and that a diminution of the beating of the heart was followed by an amelioration in the circulation in the head, a cessation of an attack of epilepsy and of various other complaints. It was something, therefore, quite different from the mere pressure on the carotid artery. These views were not absolutely complete, as I have found that another nerve which goes to the blood vessels of the brain is also irritated by the process; and that the pressure exerted in the neck produces three effects: (1) It certainly diminishes the current in the carotid artery, and indeed stops that current altogether if the pressure is considerable; (2) it diminishes the circulation considerably, and may induce a profound state of syncope by acting on the *par vagum*; and (3) it also acts on the cervical sympathetic, and produces a contraction of the blood vessels in the head, by means of which a part of the good effect is obtained.

There are perhaps no parts of the nervous system which cannot under irritation have an influence on the heart to stop it. Even irritation of the nervous fibres of the brain may produce a cessation of the activity of the heart. Physicians in this room know perfectly well that sometimes a patient stricken down with apoplexy may have a great reduction in the action of the heart, and sometimes syncope may take place, resulting in death. In the spinal cord it is so also. There are indeed parts that cannot be pricked by the finest needle without some influence on the heart. Legallois, the French physiologist, of whom I have already spoken thought that all of the spinal cord was a center for the movements of the heart, and he had made experiments which seemed certainly to show that that was the case. He had passed a small bar of iron along a part of the spinal cord, and had found that that stopped the heart's action. But he made a mistake in considering that it was because he had destroyed the nerve center of the heart.

GREATER VITALITY IN AMERICA THAN IN EUROPE.

This experiment was the occasion, as perhaps some of you already know, of my finding that animals in this country can bear an injury far more easily than the same animals in Europe. I have ascertained that it is so for man also. And this is why so many medical writers in Europe consider that facts of this kind published here are mere inventions. There is a distrust among European physicians in the honesty and uprightness of American physicians, because the former cannot understand how man in this country can survive terrible injuries which would be fatal to him in Europe. I would not say that the truth is absolutely respected in this country or anywhere else, but still

there is no doubt that the facts which have been mentioned are perfectly true. Experimenting on a rabbit before a class in the University of New-York, I had announced to them that pushing the instrument as I was about to do, along the cord, would be quite enough to kill the animal immediately. Fortunately for me, I had said that death was due to the hemorrhage accompanying the instrument, and not to the lack of the influence of the spinal cord. After pushing the instrument in for some distance, I found the rabbit which had been operated upon, eating a carrot [laughter]. The class laughed more than you do now, and not at the rabbit but at me. [Laughter.] I could not understand at first what it was due to, and I then pushed the bar of iron its full length, or nearly one-half the extent of the spinal cord, but the rabbit continued to eat its carrot. Fortunately for me and for science, I found that there was no hemorrhage at all. I then took up the rabbit by its ears and showed that there was no bleeding, and explained in that way the persistence of life. What I had said, therefore, was verified by the fact that in Europe death takes place by hemorrhage. This tendency to hemorrhage in European animals is one of the differences between the animals of the two countries, and there are other important differences.

The heart can be stopped by a blow on the belly. Long ago Dr. Hunter had determined this. The fact was known before him, but he insisted on it. But the explanation was not what he thought. But it takes science a long while to move; progress is had slowly; and in this case it was a long time before the facts were generally received and a true explanation reached. Goltz, a physiologist in Germany, has made experiments on a frog, consisting in giving a blow of the finger on the ebily; he has repeated the experiment which had been made so many times on man. Only since his time has it been known that the sympathetic nerve there has the power of stopping the heart's action. I had published different researches showing how it is that in peritonitis, which is an inflammation of the thin membrane in the abdomen, death occurs from lack of action in the heart. It is owing to an irritation of the ramifications of the sympathetic nerve in the abdomen, that the heart's action stops. This is very important to know, as if we possess the means—and we do possess them—of diminishing the irritation that takes place in those cases in the abdomen, we may save the life of the patient. It is well known that the means which frequently save in peritonitis' that is, the use of opium, diminishes the excitability, and in that way prevents the influence on the heart. That influence goes up from the abdomen to the spinal cord, and rises there to the *medulla oblongata*, and then descends from the *medulla oblongata* by the *par vagum* to the heart.

A great many facts which you may observe at water-cure establishments, show the influence that cold possesses, by acting on the skin, in diminishing the action of the heart. There are a great many persons who are said to have no reaction after having been submitted to a cold douche or shower, and there are many who are in danger of dying from this treatment. Indeed, the person I know most intimately is absolutely unable to receive a douche of water without being in danger of dying from a cessation of the heart's action. In experiments made by two friends of mine, Dr. Dickinson and Dr. Bence Jones, they pushed so far the influence of cold water on the skin that they had actually had an arrest of the heart's action. It shows, therefore, that there is danger in the douche or shower-bath, and that persons who have not the proper reaction ought not to continue to expose themselves to such a cause.

There are many other causes that may stop the heart's action. It is perfectly well known that emotion can do it. In all such cases it is by pretty much the same mechanism. Chloroform kills in that way. One or two breathings of chloroform may be sufficient, by the influence exerted on the ramification of the *par vagum* in the lungs, the irritation going up to the *medulla oblongata* and then down to the heart and arresting its action. This is only to be feared, however, in persons whose nervous system is very excitable.

In the larynx we also find what an effect may be produced on the action of the heart. I have ascertained that by putting carbonic acid in the larynxes of animals, the heart's action may be stopped immediately. Still I am bold enough in many instances to push carbonic acid with great violence toward the larynx, when it acts at the same time on the mucous membrane of the mouth, and loses something of its bad effect which consists in the arrest of the heart.

DANGEROUS METHODS OF CURING HEADACHES.

In one instance I found that a mode of curing headaches which is now employed may be liable to fatal results. A friend of mine had a very bad headache. I thought that if I could galvanize the cervical sympathetic in the neck, which goes to the blood-vessels of the head, I should produce a cessation of the pain almost at once. I succeeded admirably, but I almost succeeded in killing my friend. The heart's action stopped, and he was in great danger of death from a galvanization of the *par vagum* which had taken place at the same time I was galvanizing the sympathetic. Since that, I have been more prudent, and have not repeated the experiment. Many physicians, however, galvanize the sympathetic. They do it, it is true, in a way which is different from the one I employed; they apply the currents with more care. Still, I cannot but confess that there is danger in the process.

I pass now to what relates to the arrest of respiration. There is no doubt that the respiratory movements are all due to an activity of cells of gray matter, just as the movements of the heart are; the cells of gray matter, as regards respiration, being placed on the base of the brain and in a part of the spinal cord. The same nerve, the *par vagum*, which goes to the heart, has a set of fibers which, instead of going down, go upward, and toward those cells of gray matter in the base of the brain and spinal cord. So that if you divide the *par vagum*, having one hand by which you can act on the heart and another by which you can act on the brain, you can at will, at one movement, stop the heart's action, and in another stop the respiratory movements. The stopping of the respiratory movement is very peculiar. I have unfortunately no time to enter into details about it. But there are two kinds of nerve fibers able to stop the respiratory movements. There is one kind, according to Rosenthal, going to the larynx, acting by the nerve which is called the superior laryngeal. This stops respiration by the cessation of the diaphragm, which is the muscle that dilates the chest. This is rendered soft and inactive first, as the heart is rendered soft and inactive by the galvanization of the nerve. The other part of the *par vagum* stops respiration by another mechanism quite different, which I shall not stop to describe.

But respiration can be stopped by a great many other means which are important to be known. It is important to know, for instance, that by passing a current of carbonic acid through the larynx, we can diminish the activity of the respiratory movements almost at once.

I have seen convulsions stopped immediately by the passage of carbonic acid in that way, and the respiratory movements themselves may be stopped altogether for a time; and as you are sure that they will return if you stop acting with the carbonic acid, you have there a means of diminishing the influence of a morbid state of respiration.

There are facts which I should have mentioned regarding the heart, which relate also to respiration. If we take a pair of bellows and insufflate air into the mouth of an animal, we find that the activity of the heart is diminished. If we do the same with a view of affecting the respiration, we find that the animal does not then take the trouble to breathe. It seemed to the physiologist that first made the experiment that, as he was giving the animals all the air they needed, they would be perfectly stupid to take the trouble to breathe. [Laughter.] The reality is that they do not think at all about it. I may say that they have no power of thinking, as in many cases the activity of the mind is lost for the time. But even if the mind remains, there is a cessation of the activity of the cells that serve respiration by the irritation of nerve-fibers in the bronchia. I have ascertained for instance that if you divide the *par vagum* in the neck so that the communication between the bronchia and the brain no longer exists, if you insufflate carbonic acid into the lungs there is no more stoppage of the activity. Therefore the stoppage took place through the influence that was propagated in the ramifications of the *par vagum* toward the brain. As Hering has insisted upon, there are many facts which show that the very effort of breathing brings with it a cause that stops breathing. The very fact of drawing in air is a cause which stops the action of drawing in air. He has gone a little farther than I should go in saying that the expulsion of air from the lungs is also a cause of stoppage of expiration. It seems in reality as if these three movements, the movements of the heart, of inspiration, and expiration, had associated with them a cause that diminished them. When that cause is deficient, in morbid states, then we find the movements of the heart becoming exceedingly rapid, and we find the movements of respiration becoming exceedingly rapid and tumultuous. The regulation of those movements belongs to the proper action of those powers of arrest which exist there. As regards the heart, in cases of palpitation, for instance, we have a simple means of diminishing the palpitation; it is breathing in rapidly and forcibly a good deal of air, dilating the chest as powerfully and quickly as we can. In that way an influence is developed which I have found to be the result of the association of the nerve force that goes to the muscles of the chest and the force which descends and stops the heart's action. At the same time that the current goes from the brain to the muscles of the chest to dilate it a current associated with that goes down the *par vagum* toward the heart to diminish its action. In health at every moment this thing takes place. It takes place in a very slight degree indeed. Every act of breathing is an act which moderates the action of the heart. So then there is an admirable provision of nature by which an excessive action finds a moderation in something which takes place usually along with it.

MEANS OF CHECKING COUGHING, SNEEZING, &C.

There are many facts which show that morbid phenomena of respiration can be also stopped by the influence of arrest. Coughing, for instance, can be stopped by pressing on the nerves on the lip in the neighborhood of the nose. A pressure there may prevent a cough when it is beginning. Sneezing may be stopped by the same mechanism. Pressing also in the neighborhood of the ear, right in front of the ear, may stop coughing. It is so also of hiccough, but much less so than for sneezing or coughing. Pressing very hard on the top of the mouth inside is also a means of stopping coughing. And I may say that the will has immense power there. There was a French soldier who used to say, whenever he entered the wards of his hospital, "The first patient who coughs here will be deprived of food to-day." It was exceedingly rare that a patient coughed then.

There are many other affections associated with breathing which can be stopped by the same mechanism that stops the heart's action. In spasm of the glottis, which is a terrible thing in children, as you well know, as it sometimes causes death, and also in whooping-cough, it is possible to afford relief by throwing cold water on the face, or by tickling the soles of the feet, which produces laughter and at the same time goes to the gray matter that is producing the spasm and arrests it almost at once. I would not say that these means are always successful. I would not say that we can always prevent cough by our will; but in many instances those things are possible, and if you remember that in bronchitis and pneumonia, or any other acute affection of the lungs, hacking or coughing greatly increases the trouble at times, you can easily see how important it is for the patient to try to avoid coughing as best he can.

There is also a series of other convulsive movements more or less associated with breathing, and it is very important in those cases to counteract the influence by action on certain parts. There is a form of epilepsy which consists almost exclusively in what Basil Hall has called laryngismus. He had an idea that it was essential to open the trachea and let the patient breathe through an opening there. But this is not at all necessary, even if it did good. Touching the larynx with a sponge charged with a solution of nitrate of silver will very frequently prevent laryngismus, when it has just begun and it has very little power. But in those cases of laryngeal epilepsy, in which the convulsions come from affections caused by a spasm of the larynx, there is no doubt that this device or expedient changes the activity in the muscles, and that activity is enough to produce a cure.

There are a good many other phenomena of arrest. The most interesting are those relating to the brain. I cannot in this lecture speak of more than one of them, and that is arrest of the cerebral activity, of thought, of consciousness. It is well known that in epilepsy cerebral activity is lost. It is well-known, also, that in certain cases of syncope it is lost. In cases of sleep, also, it is lost, except of course in great dreamers, and then there is hardly any consciousness, and in any case the condition is quite different from that of wakefulness. There is an evidence that a theory which I advanced long ago to explain the loss of activity in the brain is only partially true. It was that a contraction or spasm takes place in the blood vessels of the brain, that blood does not circulate there any more, and that, as I then supposed, the stoppage of the circulation causes a cessation of the activity of the brain. But there is another cause in these cases in which there cannot be a contraction of the blood vessels, because the principal nerve which produces these contractions has been divided; and even in those cases a loss of consciousness can take place suddenly. Pricking the base of the brain may cause a complete loss of consciousness in an animal after a division of the nerves that go to the

base of the brain. We cannot attribute that loss of consciousness to want of circulation, for the blood may be circulating there. But there is another fact. If we galvanize the *par vagum* so as to arrest the heart's action, there then is no circulation at all in the brain; and if we have galvanized only the part of the nerve which goes to the heart after having divided it, so that there is no circulation at all in the brain, the animal remains conscious for eight or ten seconds. Therefore, when we find in some cases that certain irritation will produce a loss of consciousness immediately, we cannot look upon the loss of consciousness as being due to the cessation of circulation in the brain, as that cessation does not immediately cause the loss of consciousness. In cholera, too, the brain remains active sometimes, although there is no circulation in the brain, although the blood there is perfectly black. It shows that the brain may remain active when deprived of circulation, and even of oxygen. We must therefore admit that there is an active cause which produces the cessation of the activity of the brain in those cases in which it is produced by the cessation of the nervous system.

INDIRECT NERVE FORCE—THIRD LECTURE.

CAUSES OF LOSS OF CONSCIOUSNESS—NO LIFE IN THE HEAD AFTER DECAPITATION—ENORMOUS DOSES OF STRYCHNINE—SUDDEN RECOVERY FROM PROTRACTED HEMORRHAGE—VITAL REMEDIES FOR HYSTERIA.

BOSTON, March 5.—A large audience assembled to hear Dr. Brown-Séquard's third lecture on Nerve Force. He spoke as follows:

LADIES AND GENTLEMEN: I tried in my last lecture to show that nerve power can stop a good many of the most important acts that take place in our system. I have shown that the heart's action can be stopped suddenly; that respiration can also be stopped suddenly, and I shall try to show that our consciousness may also be lost suddenly by an act similar to those which arrest circulation and respiration. Galvanization of a certain nerve in the neck, you know, stops the heart's action. As regards our consciousness there are a great many circumstances in which it may be lost. Those who are in good health know full well that every twenty-four hours they will lose consciousness for a time. Persons out of health may lose consciousness in a state which we call syncope; they will lose it in epilepsy, apoplexy, and in certain forms of asphyxia. In all these cases it is possible to admit that the loss of consciousness is due entirely or chiefly to the contraction of the blood vessels in the brain.

I stated in the last lecture certain facts in opposition to that view. I shall not repeat these; but there is one point of great importance to be noted. There is a nerve in the neck which goes to the blood vessels of the brain and has the power when it is excited to produce a contraction in those blood vessels, so that circulation is stopped in a good part of the brain. There is, therefore, according to the theories which we have admitted for a long time, a cause here for the cessation of the activity of consciousness. But that cause is not the only one at work in the beginning at least of loss of consciousness, either in epilepsy or apoplexy or sleep or in the other states in which we lose consciousness; because in certain experiments I divided that nerve (the sympathetic) so that it could not act normally and produce a contraction of the blood vessels of the brain. The brain necessarily, if the heart continued to beat, received the blood, and in some of those experiments not only that sympathetic nerve had been divided, so that the blood vessels in the brain were gorged with blood—because when that nerve is divided there is more blood in the parts of the brain to which it goes—but, on the other hand, the nerve of the *par vagum* was also divided, and if I applied a galvanic battery to that part of the *par vagum* going to the heart, and which you know, by the last lecture, will produce a cessation of the action of the heart—there was, under these circumstances, a cessation of the action of the heart without any trouble in the brain but that due to cessation of circulation. In that case there was a continuation of the activity of the mind of the animal for eight or ten seconds at least. In these cases the circulation, although improved in some parts of the brain, ceased altogether after two or three seconds, on account of the cessation of the action of the heart, and still there was activity of the brain. As noticed in my last lecture, the activity of the brain will persist in certain diseases—cholera, for instance—although there is hardly any circulation in the brain, and the blood is not at all charged with oxygen, but is dark and considerably altered.

THE PHENOMENA OF ARREST.

But now, if, having matters in the same way—that is, having divided the *par vagum* so that I can irritate the base of the brain without stopping the heart, and the sympathetic has been divided so that there is plenty of blood in the brain—if then, with a needle, I give but a touch to a certain part of the base of the brain, the poor animal, in some instances, though not always, immediately ceases to feel and loses consciousness completely. He loses consciousness, although circulation continues and the brain is full of blood. The loss of consciousness, in that instance at least, is not due to a lack of circulation in the brain. There must be another cause. And that other cause, substantiated by a great many facts which I have not time to mention, is something quite similar in nature to what takes place when the heart is stopped by the galvanization of the nerve that goes to the cells of gray matter within it. It is the same thing that takes place when, certain parts of the nervous system being irritated, respiration stops also. In other words, it is one of those phenomena which have been called inhibitory, or phenomena of arrest.

It is important to know that often very slight phenomena will act very powerfully. A partition of the muscles of the eye in a person with what is called hypnotism is often quite sufficient to change the condition of the things in the state of the brain so as to make the person lose consciousness. In that case there is a condition like that of sleep, with this difference, that, when called, the person will act like a somnambulist.

It has been a question whether there is life left in the head separated from the body. Well, the experiments that show that the irritation of the spinal cord near the *medulla oblongata*, will produce a loss of consciousness independently of the loss of blood, which is also a cause of loss of consciousness. These experiments show that the cutting of the neck must also produce a state of unconsciousness. Philanthropists may thus feel assured that persons who are decapitated know nothing of their fate immediately after the blow.

SERIOUS EFFECTS OF SLIGHT IRRITATION OF THE NERVES.

I pass now to another kind of arrest or inhibitory influence. This part of my subject ought to have received the full and thorough investigation which its impor-

tance demands; but unfortunately the labor of research has been left to myself up to this time. Surgeons every day have to deal with such cases, and it is a great pity that more workers than an old man like myself do not study the subject. In many instances, under a prick or certain injuries of the nervous system, there is a cessation and sometimes a complete want of that interchange between tissues and blood which we call nutrition. The circulation, though diminished, may remain pretty active; but notwithstanding the persistence also of respiration, not so perfect as in health, though certainly quite enough, we might suppose, to produce a fair condition of the circulation. But notwithstanding the persistence of these two functions of circulation and respiration, we find that the blood in the veins is pretty much like the blood in the arteries. The change of color which we know to take place through nutrition, does not occur, and the blood returns to the heart pretty much as it has been sent out. It is red in the veins and the temperature of the body has sensibly diminished, owing to the lack of the production of heat. The interchange between tissues and blood has ceased. Is this owing, as the other phenomena of arrest of which I have spoken, to the cessation of the activity of certain cells? It is a question yet to be decided. It is very likely that it is. We find these cells of gray matter acting on the various parts in which there is a function for the persistence of life; they are pretty well scattered everywhere. My friend Prof. Lister of Glasgow has pointed out that almost everywhere, even in the walls of blood vessels, he has found cells of gray matter. We may suppose that the arrest of activity that takes place is due to a stoppage of the activity of those cells. Surgeons, as I have intimated, have very frequently to deal with conditions of arrest which are very serious. Under an emotion, or under a wound, under a physical or mental shock, a man may fall down, having the four kinds of arrest of which I have spoken. That is, an arrest or diminution of the heart's action; of respiration; of consciousness, and arrest of that interchange between tissues and blood constituting nutrition. Those kinds of arrest may and do co-exist generally. The degree in which they appear varies; but almost always in the state which we call collapse, those four things are to be observed. I may say that, strange as it may seem to the medical gentlemen present here this evening, one of the most dangerous of those is the cessation of that interchange between tissues and blood. Without any doubt, the cessation of the heart's action will kill after a time; but not so promptly as a cessation of what we call nutrition, which is really life. There are various facts relative to this.

CURIOUS EXPERIMENTS—HOW HORSES ARE QUIETED.

According to a discovery made by Prof. Shiff of Florence—a discovery which has been pushed beyond him by many others—we can very readily produce these conditions. He found that it was quite enough to touch the nostrils, as I do mine, simply passing the finger along the sides of the nose, to stop the activity of the heart and respiration, and stop consciousness in a measure. He did not find, but left another to find it, that interchange between tissues and blood is also stopped. It is well known now that most of those men who succeed in quieting violent horses, put their fingers to that part, and sometimes inside the nares. Merely touching these parts may produce some effect; pressing hard upon them has far more effect. It is not essential that the application be made there, as a pressure of the lip may produce the same thing. In some animals, rabbits and guinea pigs, if we pass needles into their chest and heart, so as to judge of respiration and circulation, we find that the needles stop altogether as we press the lips or part of the cheek. It is not that the poor creature is frightened, as when we have deprived them partly of their consciousness, or almost altogether, by the use of chloroform, the same phenomena occur. There is a very curious fact mentioned by Catlin, who traveled in the West, and wrote two volumes on the Indians. He states that the calves of the buffalo, if they are caught, and the air from the lungs of a man is strongly breathed into their nostrils, will become so fascinated by that peculiar influence that they will run after the horse of the hunter, and follow him five or six miles. It is said, and Mr. Catlin also affirms it, that in Texas, or in other parts of the country where there are wild horses taken by the lasso, if the hunter succeeds in taking hold of their nostrils, and then forcibly expels air from his lungs into the nostrils of the horse, he will follow him anywhere, and become perfectly tame. These facts deserve to be studied. I have heard that when Mr. Rarey acted so powerfully on very violent horses, both in this country and in Europe, he had something to do with their nostrils also. What he did, however, he kept in a great measure secret. That part of the system, at any rate, has a great deal to do in diminishing the activity of the principal organs. It is very natural, therefore, that such a power should be acquired by one who has done such a thing to an animal as intelligent as the horse.

There are other facts of very great importance. Those persons who did me the honor to follow the lectures I delivered here last year know somewhat of my views in regard to paralysis. I will not enter at length on that subject, but I may say that paralysis, anæsthesia, amaurosis, deafness, the loss of any of our senses, the loss of any of the powers of the mind or body, can be produced by a mechanism just similar to that which we know to exist when the *par vagum* is galvanized so as to arrest the heart's action. I will mention a number of facts which show that paralysis, which may appear suddenly, can also disappear suddenly; and if it can disappear suddenly after the cause of irritation has ceased, it is clear that it was that excitation which produced it. There are many cases on record showing that the muscles, of the eye, for instance, or the muscles of the face can lose power under neuralgia, but not a neuralgia at the very place where the muscle that is paralyzed is found. Sometimes the neuralgia is on the other side. Sometimes the neuralgia is in the arm, and it will be a muscle of the face that is paralyzed. But if you cure the neuralgia then the paralysis disappears. In the same way an irritation of the nerves of the teeth can be a cause of paralysis. There are instances of the paralysis of the two lower limbs, as Castle of New-York has shown, that were cured by the extraction of decayed teeth.

Many other cases of irritation of a nerve can produce paralysis. A small worm in the bowels, producing no pain, may cause paralysis. If the worm is expelled the paralysis may disappear in an instant. A worm may produce, as I have seen in two cases, a complete hemiplegia, or paralysis of the whole of one side of the body, and as soon as the worms were expelled the patients were well. Therefore what may seem a trifling cause of irritation of a nerve in any part of the system may produce a paralysis. In experiments on animals we find this better illustrated. The posterior columns of the spinal cord are perfectly well known now, not to serve either for voluntary motion or for the transmission of sensitive impressions to the sensoria. But if we lay bare the spinal cord and merely prick the posterior

column, paralysis may be produced, which may disappear suddenly after a time.

An experiment I made in 1854 shows also that the irritation of certain nerves can produce forms of paralysis which are very singular, and which were observed only when the spinal cord or the base of the brain had been injured in a certain way. In those experiments the brain, the spinal cord, and the nerves going to the lower limbs were not at all interfered with. The nerves in the dorsal region that were not divided had nothing to do in a direct way with the lower limbs. Yet when this division was made there was a paralysis of voluntary motion in the lower limbs, a paralysis of blood vessels in the limb on the same side, and a paralysis of sensibility in the limb on the opposite side. This strange combination of effects occurred from a mere irritation of nerves which had nothing to do in a direct way either with motion or sensation, or the state of blood vessels in the lower limbs. Therefore it is quite clear that in these cases an irritation starting from a nerve has gone to distant cells of the gray matter and stopped their activity. Thus we have something similar here again to what takes place when the heart's action is stopped by galvanizing the nerves that go to it.

THE FACULTY OF SIGHT NOT SITUATED IN A SPECIFIC PART OF THE BRAIN.

As regards amaurosis, the facts are very striking. Amaurosis is a loss of sight. I find that in man an irritation of one side of the brain can produce amaurosis in the eye on the same side; it can produce amaurosis in the eye on the opposite side; it can produce amaurosis in both eyes. And it can do something more curious; it can produce a loss of power in one-half of one eye, and that may be the eye of the same side or the eye of the other; and it may be also in two eyes. Here are six kinds of facts which can be produced from an injury in a different part of the brain. We cannot, therefore, admit that an injury has been in a part of the brain serving for the functions of sight, because that would lead to an absurd conclusion; because we find that almost any part of the brain can produce that power, and that would be to locate a nerve center of sight in every part of the brain. In experiments on the *medulla oblongata*, we find also facts which cannot be explained by an injury done to the nerve that we are irritating. I find that almost always an injury to the spinal cord or *medulla oblongata* may produce amaurosis in the eye on the same side; an injury a little higher up in the *medulla oblongata* may produce amaurosis generally on the opposite side. And if we go a little more forward in a part called the *pons varolii*, then the amaurosis is invariably in the eye on the opposite side. All these facts show that an injury to the brain as well as an injury to the nerve anywhere in our system, can produce either paralysis, or anæsthesia, or loss of sight, by a mechanism quite similar to that by which nerve cells are arrested in the heart and thereby the heart's motion stopped. I pass now to some facts relating to the same question. It is perfectly well known that sometimes physicians have the happiness in the course of an organic disease of the brain to find that they have cured their patient of paralysis. It is a rare thing, but still does occur sometimes. In some of these cases the cure has been produced by simple motion; or caused by a remedy given at the time, which given to certain other patients would not affect them. In these cases strychnia is used with more effect. I will say that if homeopathy has any foundation at any time—though I most certainly believe it has not—it certainly has no value in these cases. Strychnia must be given in great doses to affect a paralysis. It must be given in doses that will produce stiffness in the limbs, and it is at the expense of some fright in the family—but no more; a fright without risk—that a cure is obtained in these cases. That state of stiffness must be persisted in for a given time. In this way you can understand that the view which I have not time to develop has sufficient grounds.

I can understand that when paralysis has been produced there has been an influence starting from the place where the disease is in the brain and acting on cells of gray matter in the spinal cord itself. We well know that strychnia will increase the power of cells in the spinal cord. Therefore it is easy to understand that a dose of strychnine may increase the power of those cells which had lost their force owing to the peculiar influence of nerve force coming from the brain. Now the problem for medical men is, I think, clearly stated. What is to be looked for is not only what I have tried myself to do and many of my medical friends have tried to do, namely, to cure the organic disease that existed in the brain, but it is also to try to break the communication between that part and the cells of gray matter affected, or to try to give to these cells a new activity. Of other remedies having a power in that respect equal to strychnia, I know but very few.

There are a good many other facts relating to the loss of power of the various senses which I had intended to mention, but I shall only state that what relates to deafness and loss of taste or of the power of olfaction is pretty much the same as what relates to the other parts I have mentioned. I can only say that all the functions of the brain can be lost for some time through a trifling influence, just as through a considerable influence they may be irremediably lost. If we can give new life to cells which are at a distance from the place of disease, we may obtain a cure or an amelioration. There is a very singular affection which has been called aphasia. This is a loss of the faculty of expressing ideas by speech. This aphasia may occur by attacks, just as epilepsy may occur by attacks; and it may occur from irritation, just as epilepsy does. That aphasia may disappear very suddenly. In fact, there are cases on record in which the mere cure of neuralgia has cured aphasia. There are cases on record in which the expelling of worms from the bowels has made the patient recover the faculty of speech immediately. Many remarkable instances I am obliged to pass without mentioning. I saw once in London a hysterical girl who had lost completely the power of speech and consciousness almost all the time, I may say, for ten days out of twelve. She was not asleep; her eyes were open. At times she seemed to sleep. She had also a considerable diminution of the power of the heart and the power of breathing. She had, in fact, a great many of the phenomena of arrest which we find to come through an irritation of certain parts of the spinal cord, and that irritation was increased whenever a pressure was made on the spine in the neck. Treating the spine was apparently the mode of cure. The disease was, however, cured one day suddenly. A slightly different irritation had been made, and she suddenly recovered and could not understand that she had been so ill. This is what we call lethargy. This condition is certainly a type of the state of lack of activity of cells, through the influence of irritation acting upon them and producing a cessation.

CAUSES THAT PRODUCE DISORDER OF THE NERVOUS SYSTEM.

My friend, Prof. Bernard of Paris, has made experiments which are very interesting. He shows that anæs-

thetics, ether, chloroform, &c., act, not by altering chemically or otherwise the properties of the brain, but by an irritation in certain parts. The irritation is propagated to others and stops the activity there. In his experiments chloroform did not reach any part of the spinal cord; but the spinal cord had, however, lost a great deal of its power. So that it was clear in these experiments that anæsthetics acted just as galvanization acted on the *par vagum* when it stops the heart. The irritation affects certain parts of the base of the brain and thus is extended to the cells all through the cerebro-spinal system, producing a cessation of activity. There is a power in us that seems to direct our movements. That power may be stopped by the irritation of certain parts. There are three parts which, so far as I know, are able to stop that power. It is a thing worth trying. If you try to stand on one foot with your eyes closed you will find that very soon you will totter. A state is produced very much like that of drunkenness. I would not say that it will be so with all of you. But I saw many white heads here, and I had these in my mind. It is very natural when a person has turned fifty, that his power of directing movement is diminished, his power of balancing is diminished. When the eyes are closed it is very difficult to stand on one foot. That power is almost destroyed and sometimes completely so by an injury to certain parts. It is known that an injury to the cerebellum in animals destroys that power. In men it is very rarely so. Injuries in men are quite different, usually. I found that if a mere prick of the finest needle were made on the part of the spinal cord in birds where the gray matter in the center of the cord comes to the surface, that the prick immediately produced a disorder of movement. Animals affected this way go about as if they were intoxicated. Another part may be the cause of this, and this is very frequent, unfortunately, in this country. When the posterior columns of the spinal cord are diseased to a great extent, this is also what we call locomotorataxy. In all these cases, as my experiments on birds, and the experiments of others on the cerebellum have shown in all those cases, there is an influence or irritation starting from the cerebellum or posterior columns of the cord which goes toward those cells and stops their activity. Of course we do not know the location of those parts that serve to balance our movements.

The phenomena of arrest have been very well studied. It is due to a Russian physician, Sekschenom, who studied the reflex power of the spinal cord to react and produce a movement after cessation has come to it, that we know that this power is destroyed or diminished through an influence coming from the brain. It is not rare in cases of paralysis in man that this reflex power is completely lost. In that case an influence is exerted by an irritation starting from the brain, on the cells of gray matter in the spinal cord, destroying their reflex action. This reflex power exists in a very great degree in the spinal cord and *medulla oblongata* in Guinea pigs, on which I have readily produced an attack of epilepsy by a simple process, consisting in appealing to the excessive excitability in these animals when the neck is touched. Sometimes a breath of air on this part is enough to produce a fit. This reflex action of the spinal cord, however, may disappear, and epilepsy be cured by cutting a portion of the skin of the neck. A cut of half an inch has been sufficient in a number of cases. A physiologist by the name of Goltz adds to this the assertion that the power the sympathetic nerve possesses to stop the heart's action, when it is irritated, may be lost.

CONVULSIONS, AND EXTRAORDINARY MEANS OF CHECKING THEM.

I pass now to a completely different kind of phenomena of arrest. That is, the stoppage of convulsions of various kinds. The first I will speak of is a kind of convulsions which we call eclampsia. Very frequently in this case, an irritation of the skin in children, may produce a cessation of the fit. Dipping a child in very hot water, or throwing very cold water on it, may stop convulsions. In other cases the introduction of acupuncture needles, —which the Japanese have employed for centuries, and which we unfortunately do not employ enough—may have an immense power on our nerves. By what mechanism they act is unknown. It is certainly not through chemical process, since they are of platinum, and have no chemical action. An irritation of the fauces or top of the palate by nitrate of silver may stop convulsions.

Ducros, a court physician for whom the Princess Adelida had a great fancy, was an ingenious man if he was not altogether honest. He succeeded in the presence of the physicians in stoping fits or convulsions in children or men, merely by pressing the skin in the neigborhood of the ear. A pressure in the neigborhood of the nostrils may do this. If we are seized with cramps, and can put one foot flat on a very cold floor, the cramps may disappear at once. Or a drawing of the muscles so affected may act on the nerve-cells or spinal cord and stop it.

Hysteria is one of the most singular affections we are subject to. I say we, because even men are so attacked sometimes. A remarkable and successful treatment of this, which I witnessed in Paris, is so peculiar and strange, that if it were not before such a trustful audience, bold and daring as I am, when I am sure of the truth, I should not dare to mention the fact. The daughter of a friend of mine was attacked with a fit of hysteria every morning. I succeeded for a time in breaking up the fit by the use of violent means for a half an hour before the paroxysm was due. But after a time the means I used completely failed. My friend then went to see a gymnast in Paris, named Triat, who was far more daring than I am, and was in the habit of treating hysteria in a very bold and unique way. He used to take his patients, as he did this lady, up a ladder, after having bandaged their eyes so that they could see nothing. After they had ascended to the height of about 20 feet, he made them walk very carefully on a plank that was about seven or eight inches in width. He, of course, was a gymnast, and accustomed to walk there, so that he could easily lead the person forward. When the young lady had reached the middle of the plank, which was pretty long—for it was a large gymnasium—he said to his patient, "Now, you are perfectly safe, and there is no possibility of your fit coming on again." He had previously assured her that this means was infallible; had referred to hundred of previous cases, and exaggerated his success in order to act on the mind of the patient. "Now," said he, "after I have left you, you will not try to lift up the piece of cotton-wool that is fixed on your eyes until one minute has elapsed." He started away and left the patient there in great danger, as you may imagine, of falling. After a minute had passed the patient removed the bandage and opened her eyes. Fortunately for Mr. Triat no accident has ever occurred there. How many patients he cured that way, I don't know; but I know the daughter of my friend was certainly cured. The next day there was no need of taking her up there. She had had enough of it. [Laughter.]

There are many other means that may cure an attack of hysteria. The great point to be remembered is, that

faith in the patient in those cases is the principal medicine. Placing the arms in very hot water, as Dr. Ceriso has found, will stop the fit. Other means, such as the application of ice on the back of the neck when the patient does not expect it, will also succeed. A ligature tied very tightly around the limb may stop the attack. All the means of counter-irritation may be tried also. But in those cases where it is not through the mind that the attack is begun, it must be through a direct influence exerted by the transmission of nerve force to the cells that were active, thus causing an arrest. Catalepsy may be stopped in the same way. Dr. King found that by drawing on the finger of one of his patients he always succeeded in stopping one of her fits. I have seen one case of the kind myself. Many other means may be successfully employed in catalepsy as well as hysteria.

NERVE DERANGEMENTS — FOURTH LECTURE.

EPILEPSY, INSANITY, PARALYSIS, AND HYSTERICAL AFFECTIONS—CUTTING THE HEAD OPEN NOT NECESSARY IN CASES OF BRAIN DISEASE—EXPERIMENTS ON DECAPITATED MEN—MOVEMENTS OF THE BODY HOURS AFTER DEATH—A CASE OF ECSTASY.

BOSTON, March 8.—Those who braved a night's violent storm to hear Dr. Brown-Séquard were disappointed if they expected a dry season at the Lowell Institute. The lecture was as instructive and as entertaining as those that preceded it.

LADIES AND GENTLEMEN: I tried last Wednesday night to show that a good many disorders of our system may result from the stoppage or arrest of the activity of certain cells of gray matter. I shall now conclude this part of my subject. Tetanus or lock-jaw is one of the convulsive affections which can be stopped immediately by certain influences coming from certain parts of the system. The kind of tetanus that strychnine will produce can be stopped at once, as Rosenthal has discovered, by insufflating air into the lungs. He thought that it was the oxygen that stopped the attack; but I have ascertained that carbonic acid will also stop the convulsions. In the same way other physiologists have ascertained that a current of galvanism applied in a peculiar manner will, in many instances, stop the tetanus excited by strychnine; not always saving the animal, but lengthening the life and giving a chance of recovery. Tetanus, which comes from wounds or injuries to nerves, may also be stopped. Chloroform, either applied along the spine or taken internally, in both cases may produce an irritation of nerves and act on the cells of gray matter in the spinal cord. So that the mechanism of the arrest of convulsions in tetanus is just the same as the mechanism of the arrest of the heart in the case of the galvanization of the *par vagum* in the neck. I have already mentioned that epilepsy can be stopped by a mechanism of that kind. And I may add that when an attack of epilepsy is to begin, when there are certain symptoms indicating it, a great many means, indeed, can be used to prevent it. An irritation of almost any part of the skin may be sufficient to stop an attack, and the irritation itself may be of a great many different kinds. Yet in each individual case it is impossible to say *a priori* that one method that has succeeded many times with other patients will succeed with the one you have to deal with.

TRUE THEORY OF LIGATURE IN EPILEPSY.

There are cases in which there is what is called an aura starting from a limb. From the time of Galen to our own, it has been shown a great many times that a ligature bound around the limb in which this influence takes place, will stop the fit. The supposed philosophy of these cases was that something started from the limb that went to the brain, and that the ligature being applied prevented that something from passing. I have shown that the process by which the attack is prevented is just the opposite of that. Instead of preventing something from passing, the ligature irritates the nerves in the skin and sends a current toward the brain changing the state of the cells there and preventing an attack. This has been shown very clearly indeed in a great many instances that I have seen, especially since 1860, when I was connected with the Hospital for Epilepsy, at London. At that hospital I had a very intelligent nurse, to whom I had given the proper directions. There were three or four patients there, who had this particular kind of symptom. In these cases, when the nurse was not far from the patient, or when she had time to be called to them, she invariably prevented the attack. In one of those cases, that of a clergyman's daughter, there was paralysis on one side of the body and convulsions, chiefly in the paralyzed limbs, extending to the feet; always beginning by the contraction of the foot on that side. As soon as the nurse heard that an attack was pending, she rushed to her patient, and immediately pinched her first on the foot or leg of the side which was to be convulsed, and afterward on the healthy side. In every case the patient was saved. Still, it is not a rule that the fit will be stopped when there is such an aura. Sometimes the ligature and the pinch will fail, and other means must be used. For instance, in patients having some trouble internally, the relief is found in giving at once something which will irritate the nerves of the stomach very powerfully: either brandy, or gin, or rum, or ammonia, or some similar medicine. And if the stomach be empty the chance of preventing an attack is greater. An immense number of facts show that it is almost always possible to save epileptic patients from an attack if there is time enough to apply the proper means. There are other facts which show that an attack may not only be prevented, but that epilepsy may be cured by means of irritation of certain nerves in the periphery of the body. Unfortunately, however, the means that I now mention, though they have been accidentally employed with great success, are too barbarous to be generally employed. There are many cases of epilepsy that have been cured by a mere accidental burning, by a fracture of the limb or by the wounding of a limb or part of the trunk. In fact, an irritation in any part of the system may sometimes be the means of curing. Unfortunately, we do not know when we deal with epileptic patients what change there will be in irritating one part rather than another, and we cannot torment our poor patient to death by trying the whole surface of the body to see what will best serve to irritate the nervous centers.

CURING INSANITY BY IRRITATING THE NERVES.

Another kind of stoppage or arrest of the activity of cells consists in the arrest of the mental activity of the brain. In treating of epilepsy I have spoken partly of this subject, but what I have to say now is distinct from what I have previously said. Take a patient who is insane. There are many cases published in the medical journals, relating to insanity, showing that a large number of patients have been cured suddenly by means of

irritation of the skin, that was either accidental or employed by a physician. There are other means more curious and equally effective, as in the case I am about to mention. A patient in a lunatic asylum met another one, who struck his head and broke the cranium on the right side. The brain oozed out; a good deal of it was lost, and the patient was cured of his insanity and epilepsy. [Laughter.] This is rather a dangerous means of treatment, however, and of course I speak of it only to show that an irritation brought to the brain may often cure. It is in that way that bold surgeons—as many there were in this country in the period from 1825 to 1859—who have brought their instruments to the cranium and made an opening there, in cases of epilepsy, in search of a disease at that place that did not exist, have very frequently cured their patients. But not because they have taken away the disease that they supposed existed there, but because they have produced an irritation which has done it. But I may add that it is not necessary to open the cranium, though it has been done, to my own knowledge, more than fifty times in this country. All that is called for is an irritation of the skin of the cranium and of the fibrous band that covers the bone between the skin and brain. Irritation there has a very good chance of curing epilepsy in many very obstinate cases. There are many cases on record showing that an inflammation in almost any of the organs of the body is sufficient to check insanity. In the same way other affections of the brain, such as amaurosis or paralysis, may be cured suddenly sometimes without any cause that we can find, but with good ground certainly to believe that an irritation has acted which has produced a change in the cells of the brain and diminished their morbid activity. For there are clear cases in which those affections have been cured by such irritation. Those alterations of cells that were producing an arrest of the power of sight or paralysis, have been submitted to an irritation of parts of the skin or of some viscus, and this irritation going to the morbid part and producing a change in the activity of those cells, has cured the disease. So that a double mechanism of arrest may take place in all these cases. There is in the brain an irritation starting from the place where there is a disease. That we can see after death. That irritation goes to parts at a distance and acts on cells to stop their activity; but another irritation starting from some parts of the body goes to the parts that are diseased and there acts on the morbidly active cells and stops their activity, so that the effect that resulted from the disease ceased. So one phenomenon of arrest produced the cessation of another.

CAUSES AND CURES OF PARALYSIS.

In reference to paralysis a view is held which seems to be in opposition to what I have said here. Paralysis is considered to result from a cessation of activity of a part of the brain from disease. Let, for instance, a disease exist in that part of the brain that we call the anterior lobe. That part is considered as being in great measure the seat of the will. That part is destroyed by disease, and we find a paralysis; and the view is, as I have said, that the paralysis results from a cessation of the activity of that part. If we admit this view, then there is no need of accepting what I have taught here: that an irritation starts from a place that is diseased and goes elsewhere to produce an arrest of the activity of cells. But that view is entirely in opposition to facts. We see every day that a disease which is exceedingly limited in extent in the brain can produce the most complete paralysis, while, on the other hand, we see that disease which has destroyed an immense part of the brain may not produce a paralysis at all. It is impossible to conclude that paralysis proceeds in a direct way from the destruction of tissue that we see after death. There must be an intermediate agency between the seat of the disease and the paralysis. And that intermediate agency is what I have tried to make you understand in saying that the irritation starts from the place where the disease is, and goes to other parts of the brain, and also to the spinal cord, to stop the activity of those parts. It will be evident to persons here who know a little about anatomy, that it is impossible to admit the old view about paralysis. In the base of the brain there is an organ which is called the *pons varolii*. This is the only part by which communications take place between the brain and the spinal cord and the rest of the body for voluntary movements. There is also another part in front which is called the *crura cerebri*—legs of the brain. That part is composed of two halves, quite distinct one from another. Let us suppose that there is a disease either in one part of the *pons varolii* or of the *crura cerebri*, and that disease has destroyed a small part of one of these. What shall we say if the view that most all physiologists have is correct? Why, that the destruction of one part of the *crura cerebri* or *pons varolii* necessarily will produce a paralysis in some muscles of one-half of the body. But that is not what we see. In cases of disease there, the paralysis may exist in the same side of the body where the disease is or on the opposite side. It may be in one arm only or in one leg only. The facts are altogether in opposition to the admitted view. You may see also cases in which the *pons varolii* is destroyed without any paralysis at all. We should say also, according to the common view, that a disease that has destroyed only a few of the fibers would produce only a paralysis of some of the muscles. There are no such cases on record. It is essential to take another view of this matter. I have proposed this explanation: that paralysis appears only from an irritation which starts from the place where the disease is, and acts upon parts at a distance so as to modify them. All of you know that a tickling of the soles of the feet produces different effects in different people. So we can easily understand that an irritation in the brain which will produce a complete or a partial paralysis in one person will produce no paralysis in another, according to the excitability of different people. Take the facial nerve now. That nerve in almost all persons who have a chronic disease of the brain is partially paralyzed, perhaps only a few fibers of it. Well, as the disease which produced this paralysis is limited in every instance, and as the disease may occupy every part of the brain, if we conclude that paralysis comes because the nervous center of the facial nerve is destroyed, we would have to place that center in every part of the brain; in one individual in one part; in another individual in another part, and so on. And as we find cases in which a destruction of a considerable part of the brain does not result in that paralysis, we would have to conclude that some individuals do not receive that nerve in their brain. This is a *reductio ad absurdum*. We have therefore to throw overboard that theory.

HALF THE BRAIN EQUAL TO THE WHOLE.

There is one point about which I should like to deliver a whole lecture. I can only say now a few words in regard to it. It is a most important topic. A study of the facts relating to the brain

has led me to conclude that each half of the brain—paradoxical as it may seem—is a whole brain. That is, that one-half of the brain is sufficient for all the functions of the two halves of the brain. If that is the case, I must mention a conclusion, although it may seem outside of my subject. It is that we are extremely neglectful in educating only one part of the body. We educate our right arm and make use of the right side of the body as much as possible, and leave the other side inactive, except in walking. We do not perform what is really needed if we have two brains. There is no question that it is our habit of making use of only one side of the body, that consigns to one-half of the brain—the right side—the faculty of expressing ideas by speech. If we developed both sides of our body equally, not only would there be the benefit that we could write or work with the left hand as well as with the right, but we should have two brains instead of one, and would not be deprived of the power of speech through disease of one side of the brain.

I pass now to quite another subject. You know that in the second lecture I said that I would examine two series of facts, one showing the power of arrest of activity that nerve force possesses, and the other having just the opposite object, that is, to produce an activity instead of an arrest. I now come, therefore, to the study of the production of the various kinds of activity that the nerve force possesses. The first question I have to examine is that which relates to the influence of nerve force in producing muscular contraction. It is essential first to say a few words on the power of muscular contraction and to see if that power is distinct and independent of nerve force. There have been a good many different views about this; but as I have little time I shall only say that the view is almost universal now that the nervous system is not essential to the existence of muscular contraction or irritability; that contraction can take place without any interference of the nervous system. My friend, Prof. Bernard of Paris, made some ingenious experiments on this subject. He found that the poison woorari affects the motor nerves in muscles, so that the conductors which unite the brain with the muscles become paralyzed, while the muscles remain active. He drew the conclusion that muscles remain connected with the brain as regards their activity. But there is an objection to this which I put forward long ago. It is not clear at all that in that case the muscular power in the fiber is lost. There is a state of things, anatomically and physiologically, inside of the sheath of the muscular fibers, which renders it very doubtful that the woorari acts upon those parts, and it may be that the nerve power remains inside of the sheath of the muscular fibers. The same objection can be made to the facts relating to the section of nerves.

A MAN STRONGER WHEN DEAD THAN ALIVE.

It is well-known that if a nerve has been divided, after four days it loses its power. The muscles, however, remain perfectly active, and we can produce contraction in them. Unfortunately, here, also, there is an element of nerve tissue, which is inside of the nerve sheath, and it is not known whether it has lost its power or not. In the case of two decapitated men, I made an experiment of cutting off the arms. I found, after thirteen and a half hours in one case and fourteen hours in the other case, that all signs of life in the limbs had disappeared. Up to that time, either galvanism or a shock produced by a blow with my arm or a paper-cutter, caused the muscles to respond to the irritation. I then injected the blood of a man into one of these arms, and the blood of a dog into another. In both cases local life was restored in those arms. The muscles became irritable again, and the strength of contraction was extremely powerful. Indeed, in the arm in which the blood of the man had been injected, the power was immense. It was greater certainly than during life. There was therefore a return of muscular irritability after it had disappeared, and nervous excitability had not come. The nerves remained quite dead. Therefore it seemed quite clear that the muscular irritability depended upon nutrition by blood and the oxygen in it. The blood injected was richly charged with oxygen and that was the reason why the muscular irritation became so great. There was more oxygen than usual. As the nerves had not regained any power at all, it was not through any influence of the nerves on the muscles that the part had re-acquired life. There also we find, however, that same objection, that we do not know whether the elements of the nervous tissue which are inside of the sheath of muscles had lost their power or not.

But there are other facts more decisive. Professor Simpson of Edinburgh examined the power of contraction in the umbilical cord—the cord which unites the fœtus to its mother. In that cord the contraction by galvanism was made with great intensity. Some physiologists have thought that there are no nervous centers there. If there are any, they are very small. In the iris of an eye I have found a singular fact. Long ago I had discovered that light can affect the iris of the eye, even when it has been removed from the body. The eye of the eel had been removed from the body for sixteen days and kept at a temperature of about 36° to 40° Fah. But I found that although the eye was in almost complete putrefaction, the light still acted as an irritant of muscular fibers. There it was impossible to admit that there was nervous action. The muscular fibers themselves were considerably altered. Still they acted.

But there is a fact which is more decisive to show that muscular irritability is independent of the nervous system for its existence. It is that if we strike a muscle that is dying away, we produce a ridge at the place we strike. All the fibers in the muscle contract at that place. And as it is impossible to admit that in those cases there has been a nervous action in every elementary fiber, because the parts I spoke of, which are inside of the sheath, are generally in the middle of the length of the fiber, and any part of the muscle may react in that way, it is, therefore, impossible to admit that there is any nervous action in those cases. Therefore, they show that muscles are independent of nerves for their action.

I pass now to a class of movements which we call rhythmical. It is well known that the heart performs them. It has been questioned whether these movements depended on the nervous system. There is no question indeed that in a normal state—I do not say in every state—the rhythmical movements of the heart depend upon cells of gray matter which are inside of the heart itself. The diaphragm, the most important of the muscles of respiration, possesses, like the heart, the power of contracting rhythmically quite independent of the brain, the spinal cord, and the *medulla oblongata*. In almost all experiments we find that when we destroy the brain or *medulla oblongata* we destroy the movement also of the diaphragm; but that is by the phenomena of arrest. We arrest the movements of the diaphragm there as we arrest the movements of the heart when we galvanize the *par vagum*. But if we operate in a certain way we may succeed in separating the diaphragm com-

pletely from the spinal cord by the dissection of the diaphragmatic nerves, and we may see the diaphragm continuing to act perfectly in a rhythmical way. We see it even when we have rendered the warm blooded animal on which we operate almost cold-blooded by diminishing the temperature constantly. The diaphragm, therefore, possesses the power in itself of rhythmical movements.

MUSCULAR MOVEMENTS AFTER DEATH.

What is the duration of those rhythmical movements when the parts are separated from the body? It has been found that 48 hours after the heart has been separated from the chest of a dog it continued to beat. There is recorded the case of a man at Rouen in whom the heart was found to beat for 36 hours after the death of the body by decapitation. There is therefore a possibility of long persistence of life in those organs. And I dare say that the great cause why we see those organs stop at death so quickly, is that the phenomena of arrest of their activity have taken place at the time of death.

There are many other parts that possess rhythmical movements; the great vessels near the heart; the arteries of the heart in certain animals, as Prof. Shiff has discovered; the vessels of the wings of the bat, as Wharton Jones has discovered, and the excretory canals of either the liver, or the pancreas, or kidneys in some animals. Then also certain parts of the digestive apparatus of birds, separated from the body, may continue to act rhythmically. Indeed, I have found that every muscle in our system, as well as in animals, can in certain circumstances, have perfect rhythmical movements; so that these regular movements do not depend on a peculiar organization belonging either to the heart or to the diaphragm. It is a property which every contractile tissue possesses, and which shows itself only in certain circumstances different from the ordinary circumstances of life.

The next point I shall mention is that movements voluntary in appearance can exist without nerve force. In that respect a very singular fact has come to my knowledge in a positive way. I was called once to see a patient who was indeed no more a patient; he had died before I reached him. I was told that he was making certain movements, and his family and friends all thought he was alive. I examined him and found that he was certainly dead without any chance of returning to life, at least according to our very limited knowledge. I found that he was performing slowly movements that he had been performing with great vigor before I came. He would lift up his two arms at full length above his face, knit the fingers together as in the attitude of prayer, then drop the arms again and separate them. The movements were repeated a good many times with less and less force, until at last they ceased. These singular movements, to persons not knowing what may take place in the human body after death, must certainly have looked as if the will-power had been directing them. Evidently there was no such thing there. The heart had stopped beating; the respiration had ceased for a long time. The appearance of the eyes and of the other parts of the body were those that we observe in death. There was no trace of sensibility anywhere; no reaction to the operation of galvanism or burning anywhere, as I had to make use of these means to satisfy the family. A needle was pushed into the heart, as there was no danger from this experiment, a certain physiologist having, for the mere sake of showing what the Japanese had done that way, introduced one many times into his heart. The needle introduced showed that the heart of my cholera patient did not beat. But what I did not do, the proof I did not have in this case, Dr. Bennett Dowler of New-Orleans has given. From patients who died of yellow fever or cholera—and it is chiefly in those cases that involuntary movements resembling voluntary ones occur after death—Dr. Dowler has amputated limbs. It was a bold undertaking; but Dr. Dowler has done it, and the limbs amputated continued to move after having been separated from the nervous centers; so that if there was nerve force acting, then it was nerve force existing in trunks or nerves and not the nerve force that comes from the will. Those movements, I repeat, resemble voluntary movements.

EXTRAORDINARY FEATS CAUSED BY DISEASE.

There are movements which of course require more force, but which resemble those movements in not being directed by the will. The field of pathology is indeed very rich in cases in which all sorts of movements resembling voluntary movements are made by patients who, however, are not trying to perform those movements. There is one case especially of a young lady in Paris who was attacked with ecstacies every Sunday, and who performed a feat the thousandth part of which not one among you could perform unless you were diseased like her. Every Sunday at 10 o'clock the young lady ascended a bed, and putting her feet on the top of the edge or border of the bed, took an attitude of prayer and began to address prayers to the Virgin Mary. She continued in that attitude, fixed like a statue, except that her chest continued to move and her heart to beat, and the lips were giving utterance to sound. All the other parts of the body were absolutely motionless. This was a feat that you could not perform on level ground. Standing rigidly on tip-toe, even without shoes, is an utter impossibility, beyond a short time. I ventured to try my own power on the border of that bed, and fell immediately. [Laughter.] I was not ready to try it again, as there was no doubt that the thing was impossible. I had been called by the agent of police to see whether there was disease there, or whether it was a false pretense to make money, as the family of the girl was poor, and many came and paid for the privilege of witnessing her attitude in prayer. It was clear that there was disease. I made an experiment which proved it.

There are other movements which are performed without the will. Some of these are very singular. Sometimes it is a movement forward, sometimes it is a movement backward as fast as possible; then movements sideways, or a movement like a horse in a circus, or a simple rotation executed on the same place on the feet. What may surprise many persons, there are two cases to my knowledge in which these rotary movements, instead of being performed as I just performed them, were performed with the head on the ground. [Laughter.] The feet were against the wall, without which, of course, this action would be impossible. The patient turned with a rapidity that was wonderful. No person with will-power could have done it. The head spun around as if it were a top.

In another case, I saw a most beautiful Irish girl who had a blow on the head and who had a rotary movement on that account. She knew well what was the matter with her, and had come to be able to prevent any bad effect of it. If she wanted to go in a contrary direction she turned herself in a direction almost at right angles to it, and the irregularity of her movement brought her to the right place. [Laughter.] She knew the amount of her rotation, her deviation from a straight line, and calculated accordingly. So when she went along the stree

she executed a series of half-circles and in that way succeeded in going forward. She was in perfect health otherwise. She could not help this. There was an irresistible power pushing her so. Her will force could not overcome it.

The most singular of these rotary movements are those that the ear will produce. An injection of cold water in the ear will produce a very great change sometimes. In a curious book of a Frenchman of Alsace—perhaps he is a German now [great laughter]—there are, I dare say, more than three or four hundred of those strange cases of rotary movements or change of direction by something acting against the will. These diseases are particularly common in women, and a great many of the cases are allied to hysteria; but they exist from an organic cause in man sometimes also.

SUMNER'S SUFFERINGS—FIFTH LECTURE.

THE FORCE EMITTED BY THE [illegible] QUENCES OF IRRITATING PARTICULAR NERVES—PEOPLE SAYING THINGS THEY DON'T WANT TO SAY—SNEEZING 50,000 TIMES IN 83 HOURS—TREATMENT ADOPTED IN SUMNER'S CASE—WHY AND HOW HE ENDURED THE TORTURE.

BOSTON, March 15.—Dr. Brown-Séquard's fifth lecture on Nervous Force would regularly have been delivered on March 11, but a summons to Washington to attend Mr. Sumner postponed the delivery until last evening.

It was evident when the lecturer appeared on the platform that he was suffering much agitation. Some moments elapsed before he could obtain possession of his voice, and when he did speak there was a tremulousness in the utterance which showed the deep emotion that swayed him. His allusion to Mr. Sumner in opening his lecture was more affecting than a simple report of his words can indicate. When, after talking a half hour, his subject led him once more to return to Mr. Sumner's case, the Doctor broke down completely, and was obliged to ask the audience to excuse him for the remainder of the evening.

LADIES AND GENTLEMEN: For the second time in lecturing here I have to beg your forgiveness for being moved in the way that I am. Since 1857 the eminent man that has left us has been under my care, and has been also a very dear friend. I sympathized with him in every one of the generous impulses that led him to occupy such a high rank in the history of this country. And therefore it is easy for you to understand that I am now hardly able to say more about his greatness, and the blow that our country and you in this city, and I, as his friend, have received. In a few minutes, when a little more master of my nerves, I shall have to say something about him professionally; something which I have never mentioned but to a few friends, as so long as he lived I knew that a modesty by far greater in him than anybody knew, would have been wounded if I had spoken it aloud as I shall to-night.

EXTRAORDINARY CONSEQUENCES OF IRRITATING THE AUDITORY NERVE.

I now come to the subject of this lecture. You remember that in the last lecture I gave facts to show that the greatest disorders may occur repeatedly and aim at constantly under the influence of the irritation of the nervous system. I shall now mention a few more of these facts. When we inject cold water in our ears, we [illegible] movements [illegible] at once. In certain animals, if we prick a certain nerve—the auditory nerve—we find that a number of strange phenomena will occur immediately. In the first place, when the poor creature tries to move, it turns around and around. It is hardly in its power to walk straight forward. It turns around like a horse in a circus. But what is more surprising, what answers in the animal to the left arm, on the opposite side to that where the [illegible] torsion; that is, the thumb, or what represents it, is turned outside, and this connection remains always the same as long as the animal exists. Besides, there is a considerable increase in the susceptibility of the skin. Frogs, as you well know, very rarely produce a sound of the voice, but they shriek under this treatment very frequently.

In superior animals, and in the mammals particularly, an injury to that nerve produces also very frequently great disorderly movements. Those phenomena have been considered as depending on something else than the irritation of the nerve; there are semi-circular canals in the ear which have been considered as having peculiar power. But I think the question is clearly decided, for in frogs we can reach the nerve without touching at all these semi-circular canals, and we produce these phenomena I have mentioned. It is thus certain that the nerve of audition has a power in that way to produce very disorderly movements.

In man an affection of this nerve is frequently followed by the greatest disorder. I have been called more than once to see patients who have been considered as afflicted with a serious affection of the brain, but who had nothing but an affection of the auditory nerve, more or less quickly controlled, and at any rate not threatening a fatal termination as the supposed disease would have done. In one of those cases an abscess in the mastoid bone, behind the ear, was the cause of all the trouble. The abscess was opened and the patient got well. I saw the patient at Elmira, and the able physician who performed the operation, and the cure was perfect.

[illegible] be taken for [illegible] disease.

There are some other cases which consist not merely in a disorder in movement, but also in some disorder of the mind associated with it. There are cases in which, through some irritation, a patient will utter certain words and not always the most desirable words. A most eminent mathematician—one of the four or five most able and ingenious mathematicians of the age—is suffering from this affection. He is certainly, as regards power of mind, above most men with whom I am acquainted. But very frequently, under this affection, a word, and often one which no man in society ought to utter, will come to his lips. He has sometimes the power of contracting his lips before the sound comes out, so that he may be saved from the mortification of being heard. But sometimes it occurs with such rapidity that it is uttered fully, and the poor man has the mortification of saying something that very few educated men would say. [Laughter.] My friend Dr. E. C. Seguin related the case of a clergyman who was troubled in this way, and whose affection took a peculiar form. Immediately after having begun the Lord's Prayer, after having said, "Our Father which art in Heaven," he invariably exclaimed, "Let Him stay there." [Great laughter.] Of course he had to give up preaching.

A lady of the highest nobility in England had to leave court for a similar reason. She gave utterance to the

most unpleasant things for people to hear: "You are very stupid;" or, "This is a madness in you." And she said those things to the Queen or to anybody else, and that quite suddenly, frequently interrupting a conversation for the purpose. In two of those cases, that of the mathematician and the lady, both of whom I have seen, I have ascertained that the affection was dependent on the irritation of certain parts of the stomach and bowels.

Once a patient, a young lady, was brought to me by her father. My office was up stairs at the time. I happened to be down stairs when the gentleman came. I asked him to go up, and told him I would follow in a few minutes. The father turned to me and said, "Please pay attention." I did not know what he meant, but I said, "Is your daughter so very ill?" "Oh, no, but just listen." I listened, and just then the lady called out, "Hoo! hoo! hoo! hoo!" (imitating a peculiar unreportable tone, in which the sound was uttered.) His daughter was afflicted with that peculiar trouble which has no name in science, which consists in the ejaculation of the sound of a word. Some of those patients, especially those who are hysterical, bark like dogs; which has given rise to the name hysterical barking.

There are many other facts which show that even attacks of the great convulsive affections may be brought on by a mere touch, or mere tickling. When I was lecturing in St. Bartholomew's Hospital in 1858, a young patient came to consult me, who was an epileptic, and who could not be touched in the back part of his head without having an attack. He committed suicide soon after. His fellow-students there had the cruelty to press on the back of his head very frequently. As he had no chance in life, he thought, except in the study of medicine, and as he could not endure the treatment he received there, he was thrown into despair, and so committed suicide.

CONVULSIONS AT A TOUCH—NERVES GOVERNING BLOOD-VESSELS.

My very able friend, Prof. Edward H. Clarke, has found in one of his patients that the touching of the breast brings on a fit of epilepsy. I have seen a number of cases in practice, in which the irritation of one part of the skin produced an attack immediately. In Guinea pigs, as I have said, it is quite enough to tickle the neck, or sometimes it is apparent to blow upon the neck to have an attack appear. Tetanus may be excited in the same way. It is so frequently in hydrophobia, the touch of the wound produced by the bite of the dog being enough to occasion an attack.

A friend of mine, Dr. Bastian of Paris, has seen a case of hysteria in a man who had a tumor in the ear which could hardly be touched without some convulsive phenomena occurring. The tumor was removed and the patient recovered. Catalepsy is of the same category. It can be produced in some persons by merely striking the body. I had one case of that kind in London. The patient was the daughter of a physician there. A simple touch of a part of the spine was sufficient to produce an attack. Chorea and a good many other affections may be thus produced. In one case, sneezing was performed 50,000 times, according to the record of a physician, in 82 hours, owing to the simple irritation of the auditory nerve. When that was cured, the patient ceased to sneeze.

The next series of facts I have to speak of consists of alterations of nutrition excited by nerve force. For many years, before a great discovery was made as regards the action of a certain class of nerves on blood-vessels, there were physiologists who admitted that blood-vessels were controlled by nerves; but facts had not been brought forward proving it positively. I had an opportunity with a friend of mine, Dr. Tholozan, who is now the eminent physician of the Shah of Persia, to see how nervous influences can be exerted on blood-vessels from dipping one hand into cold water. If one hand is dipped into water at nearly freezing point, we find that the blood-vessels of the other hand are contracted, and as a consequence of that, there is a diminution of temperature. In one case this diminution of temperature was so great, owing to the lack of circulation there, that my friend lost 21° Fah. in ten minutes, the temperature of the air being very low that day. We found that on certain days we were more excitable than others. The mechanism was simply this: The irritation of nerves in one arm, when dipped into water, is propagated by the spinal cord and goes to the blood-vessels in the other hand and produces a contraction there, which remains, so that no blood reaches the part. Such an effect we sometimes see in people from an exposure to cold air, which may produce what Marshall Hall calls *digitis semi mortuis*; that is, fingers half dead. The fingers seem to be dead, and really there is no circulation in the part. How life can be maintained there is a mystery. It may last sometimes for days without gangrene. Most likely there is some serum there which receives oxygen, just as the serum in the cornea receives oxygen when that part is wounded. But at any rate it seems mysterious that there is no decay when there is such an absence of circulation. When we galvanize the cervical sympathetic in the back of the neck we produce a contraction of the blood-vessels of the face immediately, and all the consequences that I have noted as following such a contraction. There is a diminution of the temperature, a diminution of the sensibility, a diminution also of the vital property. If the reverse is done, if the nerve is divided instead of galvanized, then we have an opposite effect. The blood-vessels are paralyzed; they dilate considerably. There is more blood because the channel is more open. The heart sends blood with the same force everywhere; but if one part of the system is more free it receives more blood, and in consequence of the greater influx of blood there is an increased temperature, an increased sensibility, and an increase in the vital property of the part.

When I made my first experiments on the galvanization of the sympathetic, I came to the conclusion at once that those nerves most likely came in a measure at least from the cerebro-spinal system, although they belong to what we call the sympathetic nerve. I was led to this conclusion by facts which I have no time to mention. But the great point is this: I ascertained by a few experiments that it is chiefly from some nerves there, the first, second, and third dorsal nerves in the spine, that the sympathetic receive those branches. This fact was put in a more clear and forcible way by two other physiologists, Dr. Badge and Dr. Waller.

THE TREATMENT OF CHARLES SUMNER.

When, in 1857, I saw Mr. Charles Sumner for the first time, he presented to me at once symptoms which I could not but recognize as dependent upon an irritation of some fibers of that sympathetic nerve, and a paralysis of others. As you know, he received a terrible blow upon the head. His spine as he was sitting had been bent in two places, the cranium fortunately resisting. This bending of the spine in two places had produced there the effects of a sprain. When I saw him in Paris he had recovered altogether from the first effects of the blow. He suffered only from the two sprains of the spine and perhaps a slight irritation of

the spinal cord itself. He had two troubles at that time. One was that he could not make use of his brain at all. He could not read a newspaper; could not write a letter. He was in a frightful state as regards the activity of the mind, as every effort there was most painful to him. It seemed to him at times as if his head would burst; there seemed to be some great force within pushing the pieces away from one another. Any emotion was painful to him. Even in conversation, anything that called for depth of thought or feeling caused him suffering, so that we had to be very careful with him. He had another trouble resulting from the sprain which was at the level of the lowest dorsal vertebra. The irritation produced was intense and the result very painful. When he tried to move forward he was compelled to push one foot slowly and gently forward but a few inches, and then drag the other foot to a level with the first, holding his back at the same time to diminish the pain that he had there. It had been thought that he was paralyzed in the lower limbs, and that he had disease of the brain, and the disease of the brain was construed as being the cause of this paralysis of the lower limbs.

Fortunately the discovery made of what we call the vaso-motor nervous system, led me at once to the conclusion that he had no disease of the brain and had no paralysis. He had only an irritation of those vaso-motor nerves, resulting from the upper sprain in the spine. That irritation was the cause of the whole mischief as regards the function of the brain. The other sprain caused the pain which gave the appearance of paralysis. When I asked him if he was conscious of any weakness in his lower limbs, he said, "Certainly not; I have never understood that my physicians considered me paralyzed. I only cannot walk on account of the pain."

What was to be done was to apply counter-irritants to these two sprains. That was done. I told him that the best plan of treatment would consist in the application of moxas, and that they produced the most painful kind of irritation of the skin that we knew. I urged him then to allow me to give him chloroform to diminish the pain, if not take it away altogether. I well remember his impressive accent when he replied: "If you can say positively that I shall derive as much benefit if I take chloroform as if I do not, then of course I will take it; but if there is to be any degree whatever of amelioration in case I do not take it, then I shall not take it."

I did not find courage enough to deceive him. I told him the truth—that there would be more effect, as I thought, if he did not take chloroform. And so I had to submit him to the martyrdom of the greatest suffering that can be inflicted on mortal man. I burned him with the first moxa. I had the hope that after the first application he would submit to the use of chloroform; but for five times after that he was burned in the same way, and refused to take chloroform. I have never seen a patient who submitted to such treatment in that way.

I cannot conceive that it was from mere heroism that he did it. The real explanation was this: Heaps of abuse had been thrown upon him. He was considered as amusing himself in Paris; as pretending to be ill. In fact, he wanted to get well and go home as quickly as possible. A few days were of great importance to him. And so he passed through that terrible suffering, the greatest that I have ever inflicted upon any being, man or animal.

I mention this only to show what the man was, and I shall only add that since that I have always found him ready to submit to anything for the sake of what he thought to be right; and in other spheres you know that such was his character. [Applause.]

At this point Dr. Brown-Séquard was so much affected that he found himself unable to proceed, and so stopped the lecture, after having spoken one-half of the usual time.

WHAT NERVES MAY DO—SIXTH AND LAST LECTURE.

UNITY OF THE NERVOUS SYSTEM—GRAFTING A CAT'S TAIL ON A COCK'S COMB—THEORY OF CATCHING COLD—INSTANCES OF POWER OF IMAGINATION—LIMITS OF NERVE FORCE—RULES FOR HEALTH.

BOSTON, March 19.—Dr. Brown-Séquard delivered on March 18, the final lecture in his course before the Lowell Institute. The audience was large, and although the lecturer, having a half hour due him from the last lecture, ventured to add about 20 minutes of it to the regulation hour of the Institute, yet attention or interest did not flag from beginning to end, and there were not a few regrets expressed at the close that the course of lectures was terminated.

LADIES AND GENTLEMEN: I began in the last lecture to speak of the vaso-motor nervous system. That nervous system supplies the blood vessels and keeps them in a state of activity. When paralyzed, the blood vessels, not having any stimulus to contract, yield to the power of the heart and become very much larger. That nervous system exists in all parts of the body where blood is present, so that a direct influence can be exerted by the central organs of the nervous system on all parts of the body. But the question is, whether this nervous system is the only one that acts on circulation. My friend Prof. Bernard has insisted upon the view that there is another nervous system acting on circulation and serving to dilate blood vessels. This view, however, you will see in a moment, has no real foundation. The facts on which it has been grounded can be explained by quite another supposition. The second nervous system, which Bernard, and Schiff and others suppose to exist, has been presumed to act on peculiar muscular fibers in the blood vessels, so as to produce their dilatation. The ground for the view is, that by irritating certain parts of the nervous system we find blood vessels dilating instead of contracting. But it is clear, from many facts indeed, that the dilatation comes from quite another mechanism than that which is supposed by the physiologists I have named. There is evidently a number of nerve fibers transmitting nerve force to the cellular tissues, and indeed to the neighborhood of tissues, not going into any of them, but terminating between the elements of tissue, the discharge of nerve force which these fibers produce is transformed into chemical force; and owing to the activity of chemical phenomena following that discharge or transformation of force, there is any attraction of blood.

THE HEART NOT ESSENTIAL TO CIRCULATION.

As you well know, the blood circulates from the arteries to the veins, and Prof. Draper of New York has perfectly well proved that the chemical changes occurring in tissues must be a cause of activity of the circulation. But there are many other facts besides those he knew, which show that when we irritate a nerve, if there is more blood in the part where that nerve goes, it is not because that nerve goes to blood vessels, and af-

fects them by dilating them, but because of the direct transformation of nerve force into chemical force producing an attraction of blood. A great many facts indeed show us that circulation will go on without an impulse from the heart. In plants the circulation proceeds from chemical changes without any heart at all, without any power that pushes the liquids forward. In fœtal monsters in our own species, there are cases in which the monster had no heart, and in which the communication of its circulatory system with that of the almost half child with which it was connected, was too slight for the circulation to go on if we were to look upon the heart as the only organ producing circulation. Besides, in embryos, in animals at a certain degree of their development form the ovum, circulation takes place while the heart is not yet formed. And we may say that instead of the heart being the only organ that serves for circulation, that, on the contrary, the heart is formed by circulation. The circulation helps to give it a form of organization, and helps to give it a function when it has accomplished its organization.

I long ago made an experiment with frogs, consisting in making a section of the ventricle of the heart, dividing it so as to do away with more than two-thirds of the length of that part. After a time a clot is formed there which unites the lips of the cut, and the circulation goes on with a part of the ventricle, which is so small indeed that there is hardly an impulse coming from it. There is a passage, however, for the blood there, and that is all that is necessary, that the great cause of circulation, which is attraction, may be accomplished in every tissue through life. Even in our own species it has been my lot to see one case, that of a lady, in which the heart was almost entirely destroyed by fatty deposition. The heart in this case had very little action, if any, but still life persisted for some time. In appearance there was a state of health, until suddenly one day death occurred. There is on record the case of a man who for three days had had no beating whatever of the heart and who, nevertheless, had had a circulation. He had had no pulse—the beating of the pulse depending on the heart—but the blood was circulating, and life was maintained all the time. Therefore, although I would not say certainly that the heart is a useless organ [laughter], it is certainly by far less important than it was considered to be, a great deal of the work of circulation being due to the attraction that tissues exert on the blood. That attraction is increased by certain nerves, and thereby circulation is considerably increased, sometimes locally to a most wonderful extent, by an irritation of the nervous system. In cases of inflammation we see this very plainly. Where the inflammation exists inside of the cranium, we find that the carotid artery beats with tremendous violence. Sometimes we find an enormous increase of pulsation in the arteries of the temple. As we find in such cases that the heart, as indicated by the pulse in the wrist, is not beating with much more force than usual, we must conclude that there is considerable irritation and an inflammation in the membrane of the brain or the brain itself.

A CAT'S TAIL ON A ROOSTER.

If we put an organ taken from a living animal inside of another animal, very frequently this organ will be engrafted there. The infused serum becomes the object of chemical changes, the blood is attracted and the organ receives circulation. I once engrafted the tail of a cat on a cock's comb. A few days after it was evident by pricking the tail that blood was circulating in it, and it certainly would have stayed there had not the cock had a fight and lost its tail. [Laughter.] Other cases of grafting leave no doubt in this respect. It is shown by the fact that *ova* in animals when they are implanted on a mucuous membrane take hold of it, blood is attracted there and circulation takes place.

Now, the question is, does the nervous system which acts so powerfully on nutrition, as you will see in a moment, act only through blood vessels and through that peculiar influence which I had named an attraction of blood? Certainly not. Whatever be the suppositions we may make as regards the mechanism by which the alterations I will speak of are produced, it is quite certain that we cannot explain all the facts on the supposition that the nervous system affects nutrition only through the blood vessels. There must be other influences. And the variety of facts I shall mention, although not so great as I should like to present, will be sufficient, I think, to show that we cannot accept that position.

The mere division of a nerve is followed by a good many alterations, often producing atrophy not only of the muscles but also of the cellular tissue of the blood vessels, and also of the bones themselves. All the parts that were animated by the nerve are more or less atrophied after division. Dr. John Read made an experiment to ascertain whether it was because the nervous system has an influence on the nutrition, which is essential, or whether it was simply the lack of action, the perfect rest in which the part was thrown, that occasioned this wasting away or atrophy. He allowed atrophy to take place, and then galvanized the limb very frequently, and found it improved. But the principal experiment consisted in preventing atrophy by galvanization. He galvanized every day, and found that the limb did not become atrophied. I pushed the experiment further. I waited until atrophy had become considerable in the limb, and then I applied galvanism. I then learned that although the nerve had lost nerve force altogether—as they lose it four days after dissection—yet there was soon a manifest increase in size, and after a time the limb was brought to the normal size that it had before the operation.

Even in man we frequently see cases of that kind. I once had a patient who from rheumatism had been without any exercise in one of his legs for a long time and atrophy was considerable in the thigh. When the pain had diminished considerably he began to apply galvanism. I observed day after day a change for the better, and at the end of a week he had gained at the upper part of the thigh five centimeters or nearly two inches in circumference. This implied a rapid transformation for the better. It is evident, therefore, that in a great measure it is owing to rest or inactivity of a part that want of nerve action and consequently atrophy is due.

CONSEQUENCES OF IRRITATION TO NERVES.

There is a great variety of results, as I have said, when any part of the nervous system is irritated. The irritation may come in a direct way; that is, it may, if it exist in the brain or part of the spinal cord, go direct to the muscles or skin or bones or glands or part with which it is connected. But there is another way. An irritation may start from a part of the skin or mucous membrance and go up to the brain or spinal cord and be sent back by the brain or spinal cord toward other organs which become atrophied. There are a number of cases which show that an irritation in the bowels or elsewhere, in the skin, for instance, from a cut, has produced an atrophy at a distance in other parts of the body. The variety of effect produced is considerable.

On the skin a great many alterations may be observed. A bulla, which is a rising like a blister on the epidermis, a liquid being between the epidermis and the skin may be formed, or what we call pemphygus, or papulæ, which is the rising of a part of the skin with redness, or what is known under the name of herpes—all these may be due to an irritation of the nervous system. The treatment in herpes is to be that of simple neuralgia.

A gangrene may also be produced by a nervous affection. It is well known that insane patients, especially those having a peculiar inflammation of the gray matter of the brain and the *medulla oblongata*, and those attacked with what is known as general paralysis of the insane, have a slight effusion of blood in the ear and sometimes gangrene. It used to be thought that the nurses, who are unfortunately often very violent to insane patients, had been abusing them. But it is certain, also, that the trouble is frequently due to an inflammation. For there is no reason why nurses should always and especially strike them on the ear. Again, they may have had trouble in that organ when attacked; and thirdly, I have actually found that an injury of a certain part of the base of the brain produces almost invariably a hemorrhage of the ear and gangrene after it. It occurs in several species of animals, especially in Guinea pigs. So that there is no doubt whatever in my mind that the affection of the ear in insane patients is produced by a morbid irritation of the nervous system. Great changes may also occur in the hair, in the nails, and even the color of the iris may be changed from the same cause. The nails cease to grow, as Dr. Mitchell of Philadelphia has shown, in many cases by disease of the brain. They become altered in shape, and show a series of lines, depressions, and protrusions, or ridges and canals. So that a morbid influence takes place on those parts which are only secreted from the blood. The hair may change color from one day to another under a morbid influence. It may be changed not only in color but in density and thickness, and become dry or oily. There is a morbid alteration of the skin and the cellular tissue, which is not rarely observed in cases of disease of the brain or spinal cord. It is the sloughing of a part due to injury of the nervous system. It was perfectly well known that such sloughing might appear after an injury to the nervous system, yet people often called these appearances "bed sores." But we know that pressure in people who have not an irritation of the nervous system will not produce bed sores. In cases of fracture of the limbs, for instance, the patient lying in the position to have a pressure of the nates will not have these sores. But on the other hand—and these has led me to the view I propounded long ago, and which is now being accepted—in animals, in dogs, for instance, when lesion is produced, which causes an inflammation of the spinal cord and an inflammation of the nerves arising from it, we find a sloughing coming from a part of the sacrum, which is just the same as in man. In dogs, instead of lying down as we do on the back, the lying down is on the front part of the belly and on the thigh, while the sloughing, nevertheless, appears just where it does in man, on the nates. Therefore, it cannot be construed as being caused by pressure. Besides, I have seen a sloughing appear within three days after an injury, so that even if we imagined that the poor creature had turned and pressed on the part for a time, yet the length of time would not be sufficient to produce the trouble there. Neither is the explanation that the sloughing is due from decomposed water from the patient a satisfactory one. Undoubtedly this is a powerful cause of increase of the sloughing, but not the original cause, as in those animals I refer to there was not a drop of that water irritating the back.

INTERNAL ORGANS SUFFER FROM EXTERNAL IRRITATION.

All sorts of inflammation in the viscera can be produced from an irritation of the nervous system. Inflammation of the lungs is extremely common in certain cases of diseases of the brain. And inflammation of the kidneys or bladder, or bowels, may come from an inflammation of the spinal cord. Burns will produce also phenomena of that kind. A burn on the skin will frequently prove fatal by producing an inflammation of that part of the bowels called the duodenum; the inflammation may be so rapid as to produce an ulceration in a few days.

The eyes are the theater of considerable alteration from the nervous system. It is almost useless to go into a demonstration of the influence which an irritation on the nerve of one eye may produce on the other eye, because it is generally admitted now that an injury to one eye can injuriously affect the other. When I first upheld that theory I was alone in it, and it was necessary to pile up my facts; now everybody has found it out. It is quite certain that an injury to the frontal nerve then, will produce disease in the corresponding eye, and the best thing to do in those cases is to divide the nerve between the part which has been injured and the brain, so as to prevent the transmission of the injury to the brain, from which it is reflected to the other eye. In the same way an irritation of one eye may produce inflammation in the other. And if a patient who has one eye very much altered and irritated, so that it is sure to be lost, if the patient begins to have inflammation in the other eye, it is now a common thing for surgeons to take away the eye first injured to save the other. That of course acts in dividing the nerves which connect the eye first injured with the brain, and prevents a propagation of the irritation from the brain to the second eye. Even cataract and glaucoma can be produced by a nervous influence.

But more than this, all the inflammation of viscera that we suffer from may and does come from an irritation of the skin. Of the persons in this room now who suffer from coughing I dare say that nine out of ten—yes, 19 out of 20—owe their cough to an irritation which was brought to other parts than the part which, being inflamed, causes the cough. An irritation of the neck by cold, an irritation of the feet, or arms, or any other part of the body by cold, especially by damp or wet cold, may bring on inflammation of some organ. When persons have an inflammation of the lungs, almost invariably—I was on the point of saying in all cases—this inflammation has its origin, in great measure, if not entirely, in some irritation of the skin, or of the mucous membranes in the neighborhood of the skin, in the nostrils or in the throat.

POWER OF THE NERVES OVER NUTRITION.

There is a question which now arises, after having shown you how various and how great is the action of the nervous system on nutrition. It is, Are we to consider the nervous system as essential to nutrition? It is certainly not essential to nutrition, but without doubt also it is most useful to nutrition. But, unfortunately, beside being most useful to nutrition, it is in a morbid state most detrimental to nutrition. So that these three points are now particularly established: (1.) In the first place the nervous system is not essential to nutrition, which can and does go on without it, as you well know it goes on in plants and fœtuses before the nervous system is formed, and as it goes on also in completely de-

veloped animals after the destruction of certain parts of the nervous system. For instance, the destruction of a great part of the spinal cord in cats, allows the development of the lower limbs. There is an atrophy or wasting in size or girth of the limb, but the development in length takes place. (2.) The second point is that the nervous system has, however, a great usefulness in improving nutrition. (3.) And thirdly; it has a great power in disturbing nutrition, especially under certain influences, prominent among which is the application of cold to the skin. I may say here that the great danger comes from the fact that we do not expose ourselves sufficiently to cold. If we accustomed our skin to the influence of cold, then we should be in very much less danger of having any of the morbid influences that cold acting on the skin can produce.

I now approach a broad subject, about which, unfortunately, I shall not have time to say as much as I should like. In fact, it would take a large number of lectures to develop it completely. It is the power of the mind over the body through nervous force. That power of the mind over the body is much greater than most of you imagine. Indeed, I do not think that any one among you, however exalted may be his or her idea of the strength and variety of their power, has an adequate conception of its magnitude within the bounds which I will mention. You all know what mesmerizers have tried to establish. You all know what persons believing in animal magnetism profess and declare. You have heard of what is called the "od force;" and you have heard of a peculiar process which originated in New-England, and which we know under the name of Perkin's Tractors. All these views that I have mentioned have a ground in nature, and I may say there is hardly any folly in mankind of any importance that has not some ground, some degree of truth.

THE POWER OF IMAGINATION.

But though there may be some ground for it, there may not be enough to establish the truth of a certain view. The ground here is simply that the power of imagination on the body is immense, and that what is done by persons in a state of what is called mesmerism, or in any of the instances I have mentioned, which is apparently due to those odd forces—this time it has two dees—[laughter], is due to the imagination of the person under these influences. John Hunter long ago having to deal with a mesmerizer, showed very clearly what occurs in these cases. He said that he had observed of himself that by thinking of any part of the body he could very soon produce a sensation there, and if he thought of a certain kind of sensation that kind of sensation was produced. Having been urged strongly to go to a mesmerizer's, he tells us that he was very reluctant to do so because he was troubled with that serious affection known as *angina pectoris* and feared for his health. Finally he made up his mind to go, and determined to call some sensation from a part remote from that on which the mesmerizer was trying to fix his mind; so that when the mesmerizer was trying to act on his hand, saying, "Don't you feel this or that sensation when this instrument is put in your hands?" Hunter at that time was trying to give himself the gout in the big toe. [Laughter.] Hunter unfortunately knew by experience what the gout was, for he was careless of his health, and had that complaint in other and worse parts than the big toe. But this time he thought he would divert it to that member, and succeeded in doing it so well that all the attempts of the mesmerizer to produce a sensation in the fingers failed. Hunter had the true view about this, when he attributed it to the imagination. Another man of immense genius, although at times, according to my notion, he was carried away by hallucinations and illusions from a disorder in his mind; that man, Swedenborg, had also a very clear view of what John Hunter has expressed. He lived before Hunter, and therefore preceded him in this view, and he expressed it in his usual way, somewhat mystically but very forcibly, for he said that the brain had the power of conveying various sensations in it of other things to any part of the nervous system. And this is what imagination may do. But the real discoverer of this influence, the man who has established on most solid grounds the agency of the imagination in this matter is Thomas Braid of Manchester, the real introducer of hypnotism, although some three or four Americans had had a good deal of his thought mixed up with notions more or less incorrect. The influence of the mind on sensations especially is exceedingly great. Prof. Bennett of Edinburgh related the case of a butcher who was once trying to hang a piece of meat on a hook. He found suddenly that he has suspended himself to the hook instead of the meat. His agony of pain, when he discovered it, was terrible, but an examination showed that the hook had only passed through his sleeve and had hardly touched his skin. [Laughter.] The exaltation of the senses that we see, especially in mesmerized persons, may go to a most wonderful extent. Indeed, the power of the sense of hearing especially is such that it would be dangerous, if you wanted to reach the truth about mesmerism, to talk in a room adjoining the one in which was the mesmerized person, about that which the mesmerized person was to find. The mesmerized person would have a good chance of hearing what you say. All the senses indeed are exceedingly delicate then.

KNOWLEDGE OF TIME WHILE UNCONSCIOUS.

Still there is another thing than an increase of the senses. Prof. Laycock of Edinburgh has insisted on a point of great importance. If you put a watch on the back part of the head of a mesmerized person—I have not seen it, but it seems well attested—that person will know what time it is exactly to the minute, although some hours may have elapsed since the person had the opportunity to consult the time. In that case Prof. Laycock suggests that we all know that during sleep we have a power of judging of time. There is no doubt that there is such a power of knowing the time, so much so that some people can wake themselves up within a minute of a fixed time. So it is quite easy to admit that the mesmerized person knew the time by that power, whatever it is. Therefore, the power of knowing the time did not come from the fact that the watch was there; or that the hands of the watch were seen by the hair or the skin, or the bones, it was that there was a knowledge within of the real time. The way to ascertain if the person sees would be to put there a watch which gives the wrong time.

I could give a good many facts to show that even in health, in persons of imagination, a great deal of pain can be produced when there is no organic cause for it. I could show also that lack of sensation may be produced to such an extent by the imagination that pain may scarcely be felt, as in the case of the Convulsionaires of St. Mèdard. These men and women were trampled under foot in the most violent manner, and never showed the least sensibility under pain. They had come to imagine that they could bear almost anything, and did do it. There is a story of one of these poor Sisters of Charity who was struck and beaten all

over the body, and trampled on by some 10 or 12 persons over her limbs and belly and chest, and still bore it all without any sign of pain whatever.

As regards the power of producing anæsthesia, it seems to me unfortunate that the discovery of ether was made just when it was. It was, as you well know, in 1846 or 1847 that the use of ether as an anæsthetic was begun. It started from this city. At that time in England Dr. Forbes was trying to show from facts observed in England, and especially in India, from the practice of Dr. Esdaile, that something which was called mesmerism, but which, after all, was nothing but a peculiar state of somnambulism induced in patients, gave to them the idea that they were deprived of feeling; so that they were in reality under the influence of their imagination, and operations were performed that were quite painless. I say it was a pity that ether was introduced just then, as it prevented the progress of our knowledge as to this method of producing anæsthesia. My friend, Prof. Broca, took it up in 1857-8, and pushed it very far; and for a time it was the fashion in Paris to have amputations performed after having been anæsthetized by the influence of Braidism or hypnotism. A great many operations were performed in that way which were quite painless. But it was a process which was long and tedious, and surgeons were in a hurry and gave it up. I regret it very much, as there never has been a case of death from that method of producing anæsthesia, while you well know that a great many cases of death have been produced by other methods.

EFFECTS THAT BORDER ON THE MIRACULOUS.

Not only anæsthesia may be produced, but the secretions may be very powerfully affected by the influence of the mind over the body. Here we find facts of great importance indeed. There are many facts which show that the secretions of milk may become poisonous for a child from a mere emotion in the mother, and especially from anger. And if it were not the duty of every one to avoid anger it would certainly be the duty of a young mother who has to nurse a child. There are cases, although they are not common, in which death has resulted; and alterations of health in children from this cause are very frequent. A great many men who have reached an adult age owe their ill health to such an influence in childhood.

Every one knows, also, that the secretion of bile, the secretion of tears, and the secretion of saliva are very much under the influence of the nervous system. The purging of the bowels, which depends on a secretion there, or a secretion in the liver, is also much dependent on the influence of the imagination. The Emperor Nicholas tried to see what power there is in the imagination in that respect. Bread-crumb pills were given to a great many patients, and, as a result, most of them were purged. In one case a student, not of medicine but of theology, having the idea that the word pill meant a purgative, looked for "pill" in the dictionary; and the first kind of pills that he found there was one composed mainly of opium and henbane, both astringents, and capable of producing great constipation. He wanted to be purged, and took a certain number of these pills, and instead of becoming constipated he was purged just as he wished to be. [Laughter.]

Vomiting may be produced in the same way. Du Cros, a French physiologist, tells of a trial made in a hospital by a nurse who went around and gave to all the patients a very harmless kind of medicine, and then told them that she was sorry that she had by mistake given them all very powerful emetics. Out of 100 patients, 80 were affected as if they had taken the most violent emetic and vomited for a long time.

This we see on a very large scale on seaboard every Summer. I have no doubt whatever that sea-sickness is in a great measure due to that, and if you could go on board of a steamer with the idea that you would not vomit I am well satisfied, from experiments I have made, that you would escape a great deal of sea-sickness, if you did not escape it altogether. One fact I recall is very interesting. A person had crossed, on one occasion, a small bay when it was very rough. There was a man playing the violin on the boat. The person I refer to was terribly sea-sick and vomited a great deal. He had not, of course, made up his mind that he could not be sick. However, the point is that after that he could never hear a violin without vomiting. [Laughter and applause.]

To pass to something more serious: You have all heard of what are called the *stigmata*—marks representing the wounds on the limbs of Christ. Those marks have appeared in persons who have dreamed or imagined that they were crucified and suffering the pains of Christ, having invoked the goodness of God to let them have that suffering to punish them for their faults. The most remarkable fact of that kind is that concerning St. Francis of Assisi. There is no doubt that he had the mark as clear as possible. If you compare with this fact one which is related by Dr. Carter you will have the explanation of it. Dr. Carter says that while a mother was looking at her child who was standing at a window with the fingers on the border of the window just under the lifted sash, she saw the sash come down with great force and crush the three fingers of the poor child. The mother remained unable to move, feeling immediately a pain on the three fingers at the very place where the child had been injured. Her fingers swelled, an effusion of blood took place and ulceration followed and she was a long time in being cured. If in the case of this mother the imagination could produce such results, you will see in the case of the stigmata the imagination may have been equally powerful.

PERFORMANCES OF RELIGIOUS DEVOTEES.

The mind in a state of emotion has also great power on the heart, the breathing apparatus, and several other organs. The most important of the facts here—which I must say I committed the fault of denying for a long time—are those which relate to the fakirs of India. You know that they may remain dead to all appearance for a number of days, and it is even said for months, without any change occurring in their body, without any change in their weight, without their receiving any food. They show neither circulation nor respiration, as their temperature had diminished very considerably, and altogether present a series of effects which are certainly very marvelous. But marvelous as it is, the testimony of some officers in the British army who are men of perfect veracity leaves no doubt as to the possibility of the fact. But in the light of the fact that I mentioned in my first lecture, that I had a dead animal in my laboratory lying for several months without any sign of decomposition, in a temperature varying from 40° to 60° during day and night, we can understand that these fakirs may remain able to live although they do not live—that is, do not have actual and active life. But why, you will say, do they come out? Admit that there is in us a power which is quite distinct from our ordinary power of mind, which is quite distinct from what we call consciousness, which during our sleep is awake and watches; with

this admission and the facts I have mentioned before, we have all the elements, I think, for an explanation of what has been said about the fakirs.

I find, unfortunately, that the time presses so that I shall be obliged to pass over a good many facts and come to the miracles of La Salette and to the miracles accomplished at the tomb of Father Matthew, and also what has been said of a great many other instances of recovery from illness. I cannot but believe that there is no need of appealing to any other power than what we know of imagination for the explanation of what takes place in those miracles. They are very curious, but hardly more curious than what we see when we know without doubt that imagination is the cause of such a change. The cure of any illness which does not consist in any disorganization of the tissues can often be accomplished when the person thinks that it can be done. If we physicians, who treat patients every day, had the power to make them believe that they are to be cured, we certainly would obtain less fees than we do, and I must say that the best of us would rejoice at it. There is no doubt at all that if we could give to patients the idea that they are to be cured they would often be cured, especially if we could name a time for it, which is a great element in success. I have succeeded in this way sometimes, and I may say that I succeed more now than formerly, because I have myself the faith that I can in giving faith obtain a cure. I wish, indeed, that physicians who are younger men than mpself, and who will have more time to study this question than I have, would take it up, especially in those cases in which there is a functional nervous affection only to deal with, as it is particularly, though not only, in those cases that a cure can be obtained. Indeed a cure may thus be obtained in certain organic affections; even in dropsy it may lead to a cure. You know that it will stop pain; that going to a dentist is often quite enough to make a toothache disappear. [Laughter.] I have seen patients come to me with a terrible neuralgia, who dreaded the operation I was about to perform, and, just at the time I was to undertake it, ceased to suffer. [Laughter.]

LIMITS OF NERVE FORCE—LAWS OF HEALTH.

I think I have shown that the power of nerve force is exceedingly various; that nerve force can be transformed into chemical force, into motion, into electricity, into heat, into light, and so on. But what are the limits of the action of nerve force? I may say that the limits of the action of nerve force, except after it has been transformed into other forces, are our own body. Those persons who think that by an imagination, or by an act of will, or by the action of a mesmerizer, we can send in any part of our body an influence that can modify it, those persons make a great mistake if they think that this can take place by forces distinct from nerve force in the subject in which the action takes place. If we divide a nerve going to a part, never mind how much we may imagine that we can move the muscles to which it goes; never mind where we go to be the object of a muscle, we shall not have the least action in the muscles to which that nerve went. That nerve is absolutely outside of our control. Nerve force cannot be propagated to parts that are not in connection with the nervous centres. This fact is a death blow to the view that there are other forces acting in us than mere nerve force. To continue the illustration of this fact: If the spinal cord, which establishes communication between the brain and the various parts of the body, is divided, the parts of the body that are below that section are separated absolutely from any act of will, any act of imagination, any act coming from emotion, in fact, from anything that comes from the brain There is, I repeat, no force in our system other than mere nerve force for the transmissions that may come from the brain, as the seat of the imagination, the seat of emotion and the seat of the will.

I shall now add but a few words on the production and expenditure of nerve force. Nerve force is produced as you know through blood. It is a chemical force which is transformed there into nerve force. This nerve force accumulates in the various organs of the nervous system in which it is formed during rest. But if rest is prolonged, then it ceases to be produced. Alteration takes place in the part which is not put to work. On the other hand, action which is so essential to the production of nerve force, if prolonged will exhaust force also, but produce a state distinct from that of rest. Rest will produce a lack of blood, while over-action may produce congestion. The great thing, therefore, is to have sufficient but not excessive action.

There is another law which is that we should not exercise alone one, two, or three of the great parts of the nervous system; since thus we draw blood to those parts only, and the other parts of the body suffer. In the due exercise of all our organs lies the principal rules of hygiene. This view, you know, comes from a physician. It is not in agreement with what the poet Churchill wrote:

> "The surest road to health, say what you will,
> Is never to suppose we shall be ill.
> Most of those evils we poor mortals know,
> From doctors and imagination flow."

Unfortunately Churchill died a victim to this view that doctors were murderers. He died of a fever at the age of 34, and that because he had been too careless about calling in a doctor to help him. But it is certainly true that the great rule of health is not to lay imagination aside, and this is why I have quoted these verses. Imagination, on the contrary, is to be appealed to far more than we do, and this is one of the great conclusions that I hope young physicians will keep in mind.

To conclude with these great rules of hygiene, I should say that we should not spend more than our means allow us. Many commit this fault. As before said, we should make an equal use of all our organs, and of the various parts of the nervous system. Those who employ the brain suffer a great deal from inattention to this law.

Lastly, there should be regularity as regards the time of meals, the time and amount of action, the time and amount of sleep—regularity in everything. It is very difficult indeed to obtain it. But there is in our nature more power than we know, and if we conform ourselves to the law of habit things will soon go on without our meddling with them, and we come to be perfectly regular, although we perhaps had naturally a tendency not to be.

In conclusion, I have to thank the audience that has listened to me so patiently through these long and disconnected lectures. [Loud applause.]

ERRATA.

Page 14, col. 1, line 18: for "days," read *years.*
Page 33, col. 2, lines 10, 11: for "had the power of conveying various sensations in it of other things," read *is portrayed in the nerves and that they carry with them its animus.*
Page 33, col. 2, line 15: for "Thomas," read *James.*
Page 34, col. 1, line 60: for "both astringents," read *and an astringent substance.*
Page 34, col. 1, line 66: for "Du Cros," read *Durand de Gros.*
Page 34, col. 2, line 10: for "recall," read *have heard stated.*

NEW BOOKS,

In Great Demand Everywhere.

The Fifth Edition, Price **$2.50**, of

Mrs. Mary Somerville's Personal Recollections.

"To know such a character as Mrs. Somerville's, even so imperfectly as it can be set forth in print, is worth many sermons; and all the speeches at all the woman's rights conventions of a year have not so much to say to the hard common sense of the world in favor of larger opportunities for women, as the story of this life, so rich in persevering and successful endeavors.—*New York Tribune.*

A New and Uniform Edition in Six Volumes, Price **$9**, of

MARGARET FULLER'S WORKS.

Memoirs, by Ralph Waldo Emerson, and others, 2 vols; At Home and Abroad; Woman in the 19th Century; Art, Literature and The Drama; Life Without and Life Within.

THOREAU, The Poet Naturalist.

By WILLIAM ELLERY CHANNING. One vol. 16mo. Cloth. Price **$2.**

"If there be any lover of Nature who is not yet familiar with the life and writings of Thoreau, he will learn from this volume of a store of delights in reserve for him." * *

RECORD OF MR. ALCOTT'S SCHOOL.

Exemplifying the Principles and Methods of Moral culture. One volume Price **$1.50.**

Mr. Alcott established his school in the Masonic Temple, Boston, thirty-eight years ago, and the methods of education so successfully tried there were made the basis of the methods adopted at the Plainfield school in Miss Alcott's story of "Little Men," "a book which no one can afford to leave unread who has the responsibility of forming a youthful mind," says the *New York Tribune.*

Laocoon. An Essay upon the Limits of Painting and Poetry. With remarks illustrative of various points in the history of ancient art. By GOTTHOLD EPHRAIM LESSING. Translated by ELLEN FROTHINGHAM. 1 vol. 16mo. Price **$1.50.**

Send for our Catalogue. Our books are sold everywhere, or will be mailed, post paid, on receipt of the price.

Roberts Brothers, Publishers, Boston.

For Libraries, Teachers and Students.

1. Putnam's Elementary Science Series. 26 vols. 16 vols. ready. 16mo., cloth, illustrated. Per vol..... $0 75
"We cordially commend these *inimitable Manuals.* They contain just the information a well informed man desires to obtain."—*Chicago Inter-Ocean.*
2. Putnam's Advanced Science Series. 25 vols. 5 vols. ready. 12mo., cloth, illustrated. Per vol..... 1 50
"Accurately scientific, thorough, clear and cheap."—*N. Y. Evening Mail.*
3. Putnam's Popular Manuals. 12mo., cloth, illustrated. Per vol.....$1 to 2 25
"Very comprehensive in small compass."
4. The Collegiate Atlas of Modern Geography. 40 maps, large 8vo.....4 00
5. The International Atlas of Political, Classical and Historical Geography. 65 maps, letter press and Index..... 6 00
6. The Student's Atlas of Physical Geography. 20 maps and descriptive letter press..... 2 25
7. The Student's Atlas of Classical Geography. 15 maps and letter press..... 1 50
8. The Atlas of Scripture Geography. 16 maps and questions..... 1 75
9. The Mercantile Map of the World, on Mercator's Projection, 55x40 inches, in case or on rollers 10 00
10. The Portable Atlas of Modern Geography. 16 maps. 8vo 1 00
"The best low-priced Atlases in the market."—*Christian Union.*
11. The Best Reading. A Classified and Priced Bibliography. Revised edition. 7th 1000..... 1 50
"The best work of the kind."—*College Courant.*
12. Putnam's World's Progress and Dictionary of Dates. 21st thousand..... 3 50
"The best manual of the kind in the English language."—*N. Y. Tribune.*
13. The Education of American Girls. Edited by Anna C. Brackett. Third Thousand, large 12mo., cloth..... 1 75
"Should go into every family and school in America."—*Boston Advertiser.*

Complete Catalogues and specimen pages of the Science Series mailed on application. Liberal terms for introduction.

G. P. PUTNAM'S SONS, New York,
And all Booksellers.

GET THE BEST.

Webster's Unabridged Dictionary.

10,000 Words and Meanings not in other Dictionaries.

3000 Engravings; 1840 Pages Quarto. Price $12.

Webster now is glorious. [*Pres. Raymond, Vassar Col.*
Every scholar knows its value. [*W. H. Prescott.*
Best defining Dictionary. [*Horace Mann.*
Standard in this office. [*A. H. Clapp, Gov't Printer.*
The etymology without a rival. [*John G. Saxe.*
Excels in defining scientific terms. [*Pres. Hitchcock.*
Remarkable compendium of knowledge. [*Pres. Clark.*

Published by **G. & C. MERRIAM,** Springfield, Mass.

Sold by all Booksellers.

WORCESTER'S DICTIONARIES

VIENNA, 1873.

MEDAL of MERIT.

"WORCESTER."

The authority of Everett, Marsh, Alexander, Sumner, Mann, Bryant, Quincy, Agassiz, Irving, Rives, Hillard, Henry, Miles, Holmes, Felton, Winthrop, Longfellow, Hopkins, the U. S. Senate, and the U. S. House of Representatives.

Price $10. For sale by booksellers generally.

BREWER & TILESTON, Publishers, Boston.

Popular Clothing.

Our Stock of Clothing for Men and Boys is unequaled in style and workmanship, and our efforts to reduce the price, while maintaining the quality, are appreciated by a large and ever growing trade.

We offer for the Spring complete lines of Ready-Made Garments, a large and choice variety of piece Goods for Custom orders, and a full assortment of American Yoke Shirts.

Correspondence invited. Information by mail upon request.

DEVLIN&CO.

BROADWAY AND GRAND STREET.
BROADWAY AND WARREN STREET.

Box 2256 P. O.

NEW YORK.

CHICKERING

Grand, Square and Upright

PIANOS.

These Standard Instruments

which have been for more than Fifty Years before the public, still maintain their high reputation, and the award of the *Highest Recompenses* from the most critical tribunals ever bestowed upon any Piano manufacturer, places them at the *Head of all Competition.*

The leading Pianists of both Europe and America, including Dr. FRANZ LISZT, THALBERG, MOSCHELES, GOTTSCHALK, and others, have given the most flattering testimony of the

Superiority of the CHICKERING PIANOS over all others.

At the World's Fair in London, in 1851, they received THE PRIZE MEDAL.

At the Great International Exhibition in Paris, 1867, these Pianos were awarded a FIRST GOLD MEDAL, and the *Still Higher Recompense*,

THE IMPERIAL CROSS OF THE LEGION OF HONOR.

As this was declared a superior award to the Gold Medal, and as CHICKERING & SONS were the only competing firm who received this *Supreme Testimonial*, we are justified in claiming a superiority over all other exhibitors.

Persons intending to purchase a Piano are invited to send to us for an Illustrated Catalogue (mailed free), by which it will be seen that our Prices are as low as the Guarantee of First-class Materials and Workmanship will justify.

CHICKERING & SONS,

11 East Fourteenth St., New York.